A RECYCLING STUDY
FOR
NEW BRUNSWICK

Prepared for:

New Brunswick Department of the Environment

Prepared by:

Fiander-Good Associates Ltd.

in association with:

Owen Washburn Associates Ltd.

and

R. Cave and Associates Ltd.

June, 1991

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Dear Ms. Parkhill:

I am very pleased on behalf of the Study Team to submit to you fifty (50) copies of this report: A Recycling Study for New Brunswick, which includes one "camera ready" copy for further reproduction as necessary. Fiander-Good Associates Ltd. have been assisted by Owen Washburn Associates Ltd. and R. Cave and Associates Ltd. in completion of this study.

It has been a pleasure to work with you and the Study Steering Committee on this very interesting and important recycling study for the Province. We look forward to working with you in the future. Thank you.

Yours truly,

T. R. Holyoke, M.Sc. Eng.
Manager of Special Projects

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Encl.

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EXECUTIVE SUMMARY

A RECYCLING STUDY FOR NEW BRUNSWICK
EXECUTIVE SUMMARY

1.0 INTRODUCTION

o **Background to the Recycling Study for New Brunswick**

The Province of New Brunswick has set its goal to decrease the solid waste disposal requirements of the province by 50% by year 2000 through various means of waste reduction, reuse and recycling. Recycling is viewed as a key operant in meeting this goal.

This study was commissioned by the Province of New Brunswick Department of the Environment in recognition that recycling programs reduce the waste volumes required for disposal, and therefore can defer capital costs of providing new sanitary landfill disposal sites by extending the design life of disposal facilities. This in turn will reduce the operating cost of the conventional disposal systems.

However, the processing facilities required for recycled materials constitute inordinately high capital costs for plant and equipment. So the Province wants to ensure that recycling programs in the Province evolve from the outset in an economic and effective manner. Recycling provides an opportunity for the public to be involved in waste reduction in a personal way and has had widespread support from the public.

Regardless of the apparent benefits of recycling programs in reducing the volume waste materials requiring disposal and from reduction in consumption of non-renewable and managed resources, some solid waste regional committees may find the costs of recycling too high. Others may implement a recycling program but for the same reason not retain it. In hopes to avoid this latter possibility, the Province has directed this study to look at various recycling system options, and to consider the establishment of larger service areas to be served by Central Processing Facilities (CPF's) or Maximized (Wet-Dry) Recycling Facilities (MaxRF's) to gain potential economies of scale, and reduce recycling costs to the respective member Solid Waste Management regions.

o Objective of the Recycling Study for New Brunswick

The principal objective of this study has been to establish the options available for recycling and to determine their respective collection and processing cost and revenue potential, as applicable to the Province of New Brunswick. To meet this objective the study has focused on large-scale regionally integrated systems to achieve economies of scale in processing of recyclables at CPF and MaxRF plants and collection systems. The role of small-scale local recycling programs has been addressed within the context of implementation of large-scale recycling approaches.

2.0 DATA CAPTURE AND RESEARCH

o The present status of waste management in New Brunswick

In New Brunswick achieving the goal to decrease waste disposal requirements by 50 percent by year 2000 from its present status is a formidable task to say the least. Most of the Province still dispose wastes in rural dump sites which have minimal environmental control. Engineered environmentally sound landfill sites are available only in Fredericton and Nepisiguit/Chaleur regions. The remaining regions of the Province have assessed, or are in the process or are about to assess their waste management strategies.

Due to expedience, the focus of these waste management studies has been principally on waste disposal alternatives and site selection. The options of recycling and composting, as potential supplementary means to handling wastes by diverting a portion of the waste stream away from the need for disposal, have only recently received balanced attention.

The most obvious and commonly cited benefit of recycling and composting has been the extension of the operating life of disposal facilities. This reduces the need to find new disposal sites in the future. This benefit has been especially applicable highly urbanized areas, where the cost and availability of land is at a premium. But recycling programs have been shown to add to the overall costs of waste management. So while in New Brunswick the problems of finding socially acceptable (ie. "not-in-my-backyard") disposal sites are perhaps as contentious as anywhere else, potential cost savings or availability of land have not been the driving economic force supporting investment in recycling. Therefore, the appeal of recycling in New Brunswick, as elsewhere, has developed as much or more from the social preference to reduce the long-term land use and perceived environmental risks of disposal sites, as well as to reduce the end consumption of potentially reusable natural resources.

- o The present status of recycling systems experience and data

In North America most comprehensive large-scale recycling programs are in their infancy. With the exceptions of scrap metals and some oil recycling from industrial and commercial sources, as well as some newspaper recycling and returnable beverage containers from residents, most recycling programs have been established within the last 3 to 5 years. As such, most programs have been initiated and proceeded on a "learn-as-you-go" basis. Many still are. Only very recently has information from a limited number of operations been published, and a base of performance data and experience been made available.

Therefore, this study required a concerted survey effort of recycling operations to get first-hand information from operators with sufficient experience in a range of program approaches. These data and information were used to develop the analyses of recycling system approaches and diversion scenarios applied in this study.

- o The population, households and solid wastes generated per Solid Waste Management Region of New Brunswick

It has been estimated that close to one half million tonnes of solid wastes are generated and disposed of within the public systems in New Brunswick, split about equally between residential and industrial, commercial and institutional (ICI) waste generators. **Figure 1** illustrates the Solid Waste Management Region Boundaries.

- o Existing local recycling participants and programs in New Brunswick

At the time of the survey in January, 1991 there were 90 regular recycling participants and programs in New Brunswick, over and above the numerous volunteer collection fund-raising efforts of non-profit organizations (eg. schools, scouts/guides, etc.). Most of the 90 regular service recycling operations are

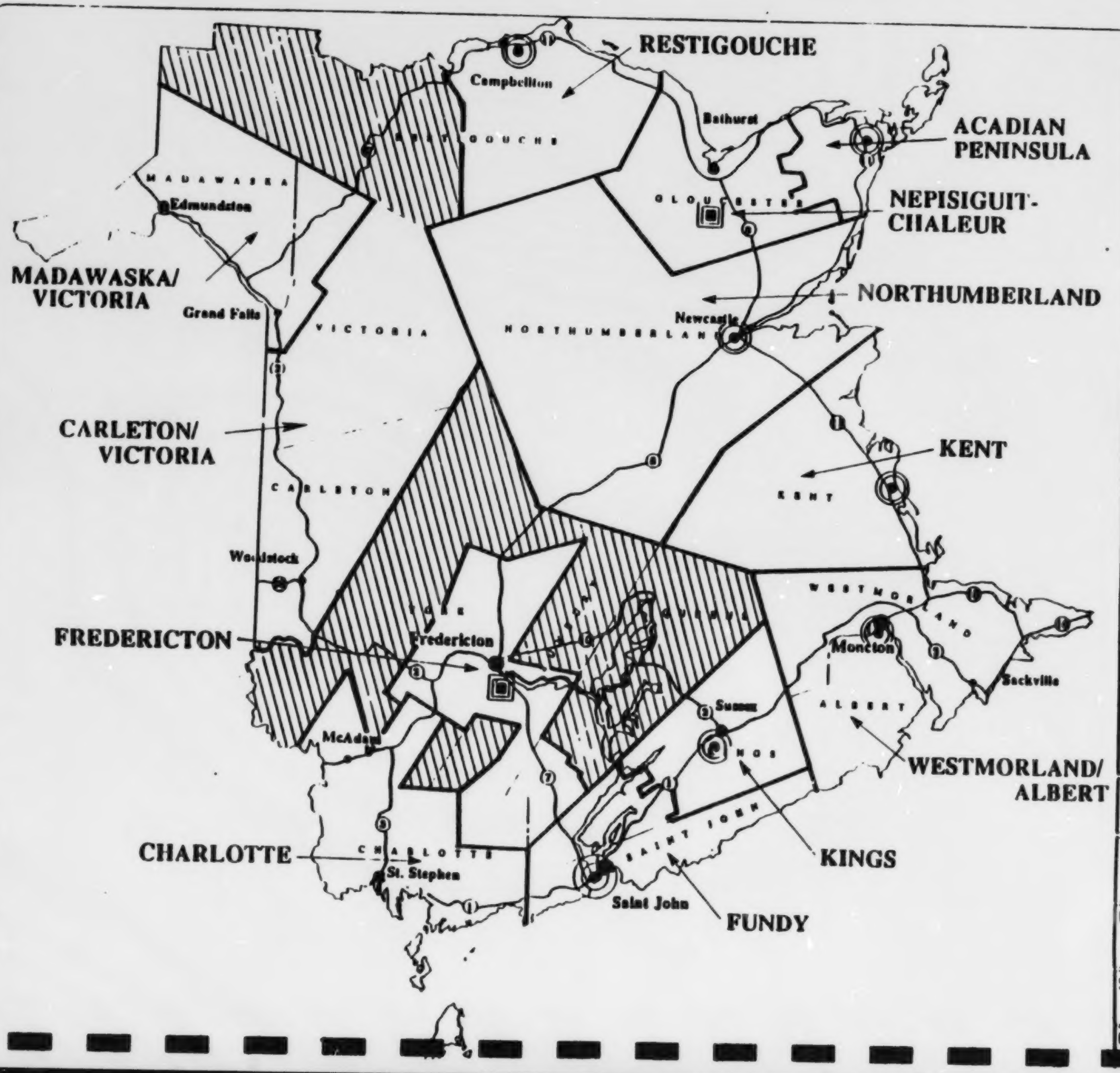

RESTIGOUCHE
Campbellton
RESTIGOUCHE
Bathurst
ACADIAN PENINSULA
GLOUCESTER
NEPISIGUIT-CHALEUR
MADAWASKA
Edmundston
MADAWASKA/ VICTORIA
Grand Falls
VICTORIA
NORTHUMBERLAND
Newcastle
NORTHUMBERLAND
CARLETON/ VICTORIA
CARLETON
KENT
KENT
Woodstock
YORK
QUEENS
WESTMORLAND
FREDERICTON
Fredericton
Moncton
Sackville
Sussex
ALBERT
McAdam
KINGS
WESTMORLAND/ ALBERT
SAINT JOHN
CHARLOTTE
CHARLOTTE
St. Stephen
KINGS
Saint John
FUNDY
Legend
Centre of Generation Hypothetical Disposal Site
Landfill Site
Area not Included in SWM Region

FIGURE 1

FGA FIANDER-GOOD ASSOCIATES LTD.

Project Title: NB RECYCLING PLAN

Drawing Title: EXISTING SWM REGIONS

Scale: not to scale

Date: June, 1991

Drawn by: JT

Job No: 612

brokers, processors and end-users of recyclable materials. Only two publicly supported residential blue-box collection programs and one drop-off depot were in operation in the Province. Five other private recycling operations provided a mixture of collection and drop-off depot recycling services primarily to businesses.

o The impacts on existing recyclers of implementing large-scale central processing facility and collection systems

Most of the brokers, processors, end-users and volunteer recycling operations would not be affected by the implementation of large-scale centralized systems, as they typically handle materials not collected in organized recycling programs (eg. beer bottles, scrap metals, auto batteries, etc.) Existing private commercial and the larger publicly-funded residential and commercial recycling programs will, however be impacted. So specific consideration should be made as to their degree of integration with the large centralized system - full, partial or no integration. This would depend upon the particular capabilities of the existing operations and facilities, the nature and capacities of the programs, their financial status and experience, and whether their operation could fulfil or support the recycling program objectives.

o The types of integrated large-scale central recycling system options and factors affecting their performance

The three fundamental recycling systems available for residential recycling are residential roadside collection, drop-off depots and maximized (wet-dry) recycling. Three approaches to ICI recycling are pick-up service, self-delivery and maximized (wet-dry) pick-up and self-delivery. The amount of materials diverted by each recycling system depends in varying degrees on any of several factors, which include:

- number and types of recyclable materials collected;
- levels of recyclable material contamination;
- convenience of participation;
- frequency of recycling collection services;
- promotion of the recycling system;
- resident peer pressure to participate;
- legislated recycling participation;

- markets for recyclable materials; and
- the cost of recycling versus waste disposal.

o **The available markets and prices for New Brunswick recyclable materials**

At present established local and out-of-province markets exist for several recycled materials generated in New Brunswick, at prices which produce net revenue beyond costs of delivery to the consuming marketplace. They include newspapers, cardboard, office papers, HDPE and PET plastic bottles, LDPE plastic film bags, clear glass bottles, and aluminum cans. Markets also exist for tinned steel cans, coloured glass bottles, mixed and other plastics, tires, various scrap metals and compost material, although they are not presently being recycled. This is partly due to the lack of or low net revenue potential of the materials, or market instability. Typically the market prices for recycled materials are volatile and their demand at times soft. Any means to stabilize and expand markets for New Brunswick generated recyclables would improve existing and prospective recycling programs.

3.0 CENTRAL PROCESSING FACILITIES AND SERVICE AREAS

Two very important planning aspects required in implementing large-scale recycling operations to serve the Province are the central processing plant design options capabilities and costs, and the selection of service areas to most economically provide recycling services to all regions of the Province.

o **The preliminary process and plant layout design, and capital and operating cost estimates of four CPF and two MaxRF plants of varied throughput capacities**

Four Cental Processing Facility (CPF) design options were provided to accommodate the range of potential recyclable material diversion levels produced in New Brunswick. Capital costs of CPF's range from over $1 million to over $6 million for annual throughput levels of up to 60,000 tonnes per single shift.

Two Maximized Recycling Facility (MaxRF) design options were provided to accommodate lower and higher levels of dry material recycling and wet material composting. Capital costs of the larger 72,500 tonne per annum (35,000 T dry and 37,500 T wet materials) MaxRF is in excess of $25 million, and the smaller 30,000 tonne per annum (17,500 T dry and 12,500 T wet materials) MaxRF is over $9 million.

Operations costs of the CPF's and the dry processing facilities of the MaxRF's vary according to the throughput levels and number of shift operations required. Better economies are achieved through use of lower throughput capacity plants utilizing two or three shift operations.

- **Analysis for selection of the most cost efficient sized areas to serve the Province with large scale recycling systems given their plant scale economies versus their line haul transportation costs**

The analysis determined the cost trade-off between recycling plant scale economies versus the line haul transportation of the recyclable materials over larger service areas. Dividing the Province into five large Central Processing Facility Service Areas (CPFSA's) shown in **Figure 2** was found to be the least-costly divisions to serve the Province. **Table 1** presents the breakdown of residential and ICI wastes, as well as households per CPFSA.

4.0 RECYCLING COLLECTION SYSTEMS

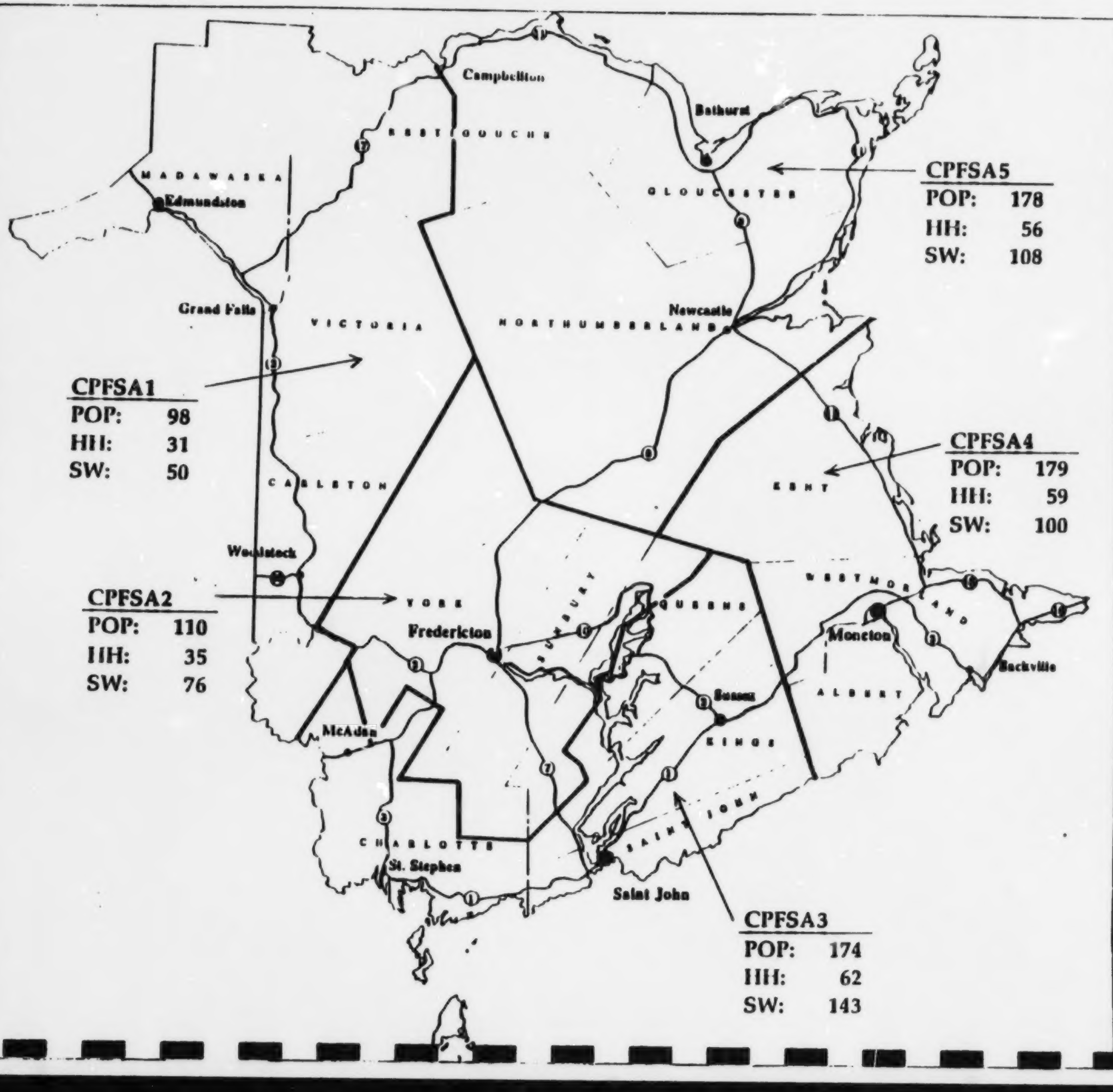
A very important component of the cost and performance of recycling systems is the approach taken to collect recyclable materials. The level and types of collection service approaches taken will impact on the rate of participation in recycling and levels of material contamination, and accordingly on the rate of diversion of recyclable materials from the waste stream.

- **Residential Recycling Collection Options**

There are two fundamental approaches to residential recycling collection:

1. Roadside Collection Recycling Systems; and
2. Drop-off Depot Recycling Systems.

In general roadside collection recycling systems have achieved much higher program participation due to the greater ease and reduced involvement required of the resident population. Drop-off depots offer a much reduced service and require


Campbellton
Bathurst
RESTIGOUCHE
MADAWASKA
Edmundston
GLOUCESTER
Grand Falls
VICTORIA
NORTHUMBERLAND
Newcastle
CARLETON
KENT
Woodstock
YORK
Fredericton
SUNBURY
QUEENS
WESTMORLAND
Moncton
Sackville
ALBERT
Sussex
KINGS
McAdam
CHARLOTTE
St. Stephen
SAINT JOHN
Saint John
CPFSA1
POP: 98
HH: 31
SW: 50
CPFSA2
POP: 110
HH: 35
SW: 76
CPFSA3
POP: 174
HH: 62
SW: 143
CPFSA4
POP: 179
HH: 59
SW: 100
CPFSA5
POP: 178
HH: 56
SW: 108

Legend

CPF Central Processing Facility Area

POP: population in '000

HH: households in '000

SW: solid waste in '000 tonnes

FIGURE 2

FGA FIANDER-GOOD ASSOCIATES LTD.

Project Title:
NB RECYCLING PLAN

Drawing Title:
SCENARIO 1A:
5 CPF SERVICE AREAS

Scale: not to scale
Date: June, 1991
Drawn by: JTGB
Job No: 612 01

Table 1

Solid Waste Tonnages Generated Per CPFSA In New Brunswick

Annual Solid Wastes Generated (tonnes)	Central Processing Facility Service Areas[1]				
	CPFSA1	CPFSA2	CPFSA3	CPFSA4	CPFSA5
Residential Wastes:	28,925	41,374	71,826	45,743	51,817
ICI Wastes:	21,042	34,112	71,165	54,101	56,484
Total All Wastes:	49,967	75,486	142,991	99,844	108,301
Total Households:	31,462	34,900	62,291	59,205	55,656

---

[1] CPFSA#1:	Madawaska/Victoria Region; western part of Restigouche County not included in Restigouche Region; Carleton/Victoria Region; and southwest portion of York County south of Saint John River not included in Fredericton or Charlotte Regions.
CPFSA#2:	Fredericton Region; northern York County north of Saint John River not included in Fredericton Region; Sunbury County not included in Fredericton Region; and northeast portion to Chipman of Queens County not included in Fredericton Region.
CPFSA#3:	Fundy Region; Kings County Region; Charlotte Region; and the portions of Queens County east of Chipman and south of Gagetown.
CPFSA#4:	Westmorland/Albert Region; and Kent Region.
CPFSA#5:	Northumberland Region; Acadian Peninsula Region; Nepisiguit/Chaleur Region and Restigouche Region.

considerably more involvement of the resident population, and typically result in much lower and inconsistent levels of program participation. Roadside collection systems have also been far less subject to recyclable material contamination than drop-off depots, although contamination problems are considerably reduced if depots are supervised. Diversion rates of roadside collection recycling programs have typically been five or more times as high as drop-off depot recycling programs. Roadside collection only would be provided for MaxRF systems, as all wastes are collected in source-separated wet and dry wheeled containers or colour-coded bags.

o Residential roadside collection recycling systems and vehicle options

The three basic roadside collection recycling systems blue box, stackable bins and blue bag, are based on the type of household container utilized for in-home storage and separation from other non-recyclable wastes.

The choice of household recyclables container will depend upon its compatibility with the vehicles chosen for roadside collection and the degree of recyclable materials separation at source. Blue box and blue bag containers are normally used for co-mingled recyclables, while stackable bins, or other multiple bins, are used where source separation is required in the home. The choice of co-mingling recyclables in blue boxes in the home requires materials separation at the curbside by collection vehicle operations. Stackable bins are used where vehicle operators dump the in-home separated recyclables in separate vehicle compartments or storage bins. Blue bags are normally used where separation of recyclable materials take place at the processing plant. However, colour-coded bags can be used to separate in-home some or all of the recyclables.

The range of vehicles used for recyclables collection vary in size and configuration, but normally include cube vans, specially designed recycling vehicles (SDRV's), packers or compartmentalized trailers.

o Residential drop-off depot recycling systems operating characteristics

There are several containers and even trailers available for drop-off depot recycling systems. However they all entail the same basic system elements, and therefore have similar costs. Drop-off depot recycling systems elements include:

- establishing drop-off depot system service areas;
- locating depot sites;
- preparing site grounds and access;
- identifying recyclable materials to be deposited;
- determining depot container system to be used;
- establishing need for site maintenance and supervision.

The annual costs of operating a network of drop-off depots proved to be higher than the more efficient roadside collection systems. This was in part due to the average one dollar per week per household cost assigned to depot systems for the resident delivery of recyclables to the depot, but was more so to do with the high costs of setting up and operating the numbers of depots necessary to provide a minimum acceptable service to residents. Finding depot sites can involve the same "not-in-my-backyard" problems, as experienced with regional solid waste management facilities.

o ICI Recycling Collection Options

ICI recyclable materials can be collected in a wide variety of vehicles and are usually chosen by availability and for type of materials collected. ICI recycling systems have not yet been clearly defined and are still in the early developmental stage, but collection services can be categorized as either pick-up or self-delivery service.

ICI recyclables pick-up services may be provided by public programs to institutions, businesses and industries as a public service. Pick-up services for ICI materials may also be provided by private collectors who pick-up recyclables either for their market value at no cost to the recyclable producers, or for a haulage fee from the producer. Several vehicles may be used for ICI recyclables pick-up services, but most commonly include cube vans, roll-off containers/trucks, or front load packers.

ICI recyclables self-delivery services simply entail the collection and delivery of recyclables by the ICI firms' own vehicles and staff. Vehicles used for this approach are those available to the firm, normally half ton, one ton or three ton flatbed trucks with side boards. Materials are collected in bags or bins by the firm and delivered when a truckload has accumulated.

5.0 RECYCLING SYSTEMS ANALYSIS

- **Analytical framework of recycling systems options costs and performance evaluation**

After reviewing the studies completed to date for the solid waste management region committees (ie. waste audits, assessments of alternatives, etc.) and being in contact with several regional committee managers, it became apparent that in most cases the regions had not yet proceeded to the stage where the Study Team could dictate, or even recommend the "best" recycling approach for the regions. Most regions have yet to select a disposal site location, some had yet to choose a method of waste disposal, and some regions were just being formed and had no information or studies completed. To complicate matters further, it was established early on in this study that scale economies of combining regions would be achieved, which would require joint decision-making among member regions of the recycling system Central Processing Facility Service Areas (CPFSA's).

It was thereupon decided that a "plan" for recycling would be inappropriate. Instead this study adopted a "shot gun" approach and became directed towards establishing and analyzing the spectrum of recycling system options applicable to each of the five CPFSA's comprising New Brunswick. This approach, therefore, will serve as an analytical resource document of the range of recycling options and their costs applied to each CPFSA to be used by the solid waste management region committees in their decision-making process.

To perform the recycling systems analyses, it was necessary to integrate compatible processing facilities and operations with collection systems according to anticipated recyclables diversion levels. Cost and revenue estimates of all component operations of the recycling systems were computed according to their respective recyclables diversion levels. The results of the recycling systems costs analyses can hereon be assessed by regional managers as parts of each region's total solid waste management system, which will include non-recycling cost components, such as disposal and collection costs of non-recyclable wastes.

The analysis began with a discussion of the Base Case and Sensitivity Tests parameters utilized to evaluate the recycling system options. The Base Case parameters reflect expected average conditions and levels of performance provided by the basic recycling options based on findings of the research phase of this study. The series of Sensitivity Tests indicate the results of the recycling system options with varied characteristics and performance levels from the Base Case parameters.

o **The Base Case Recycling Systems Evaluation Parameters**

The Base Case Recycling Systems evaluation parameters include:

- A base set of recyclable materials, Residential (newspaper, clear glass, aluminum cans and PET, HDPE and LDPE film plastics) and ICI (cardboard and office papers);
- The composition of recyclable materials within the Residential and ICI waste stream, as established from comprehensive waste composition studies undertaken in Ontario and U.S.;
- The percentage recovery of the recyclable materials by Residential and ICI programs experienced in Fredericton and other programs in Canada and U.S.;
- The set of typical representative recyclables collection systems, Residential (blue box, blue bag and stackable bins roadside collection and drop-off depot systems) and ICI (pick-up service and self-delivery);
- Average diversion rates of recycling collection systems, Residential (15% for roadside collection and 3% for drop-off depots) and ICI (25% for pick-up service and 5% for self-delivery);
- Average wet and dry materials processing recovery levels at MaxRF's from the total waste stream (60 % of Residential wastes and 66 % of ICI); and
- Average delivered market prices for recyclable materials generated in New Brunswick.

o The Base Case Recycling Systems Analysis Setup

In order to provide a complete assessment of the costs of recyclables processing and collection costs and recyclable materials revenue, it was necessary to pair Base Case residential systems with Base Case ICI systems. Although ICI recycling collection costs may not be a public responsibility, to achieve greater recyclables diversion and processing economies and revenues, ICI recycled materials must be included. The three Base Case combinations of residential recycling systems and two ICI recycling systems used for the analysis are:

- Full Service Recycling System - Residential Roadside Collection with ICI Pick-up Service;
- Minimum Service Recycling System - Residential Drop-off Depots with ICI Self-delivery; and
- MaxRF (Wet-Dry) Service Recycling System - Residential Roadside MaxRF Collection with ICI MaxRF Pick-up and Self-delivery.

o The results of the analysis of the Base Case Recycling Systems costs and revenues

The results of the Base Case analysis of the costs and revenues of the recycling system options are summarized in **Tables 2** to **6** for each of the five CPFSA's. These costs and revenues apply only to the recycling system operations, and do not include any costs of non-recycled waste collection or disposal. As such, they represent the net costs to a regional solid waste management system of providing recycling services. So it is important that direct cost comparisons not be made between the Full Service and Minimum Service Base Case Recycling Systems and the MaxRF (Wet-Dry) Service Base Case Recycling System. The MaxRF recycling system includes the collection costs of all residential and ICI solid wastes delivered to the processing plant. Only the non-recyclable and residual wastes need be transferred on for disposal. On the other hand the Full Service and Minimum Service recycling systems costs include only the collection of recyclables; the collection costs of the remaining solid wastes are not accounted for in this analysis. Therefore to ensure all three of the Base Case recycling systems are compared on an equal basis, all costs of waste management operations must be included in a "bottom - line" comparison.

Table 2
Summary of Central Processing Facility Service Area Costs and Revenues - CPFSA #1

Base Recycling System(1):	A. Full Service	B. Minimum Service	C. MaxRF (Wet/Dry)(2)
Residential Component:	Roadside Collection (15%)	Drop-off Depot (3%)	Roadside Collection (60%)
ICI Component:	Pick-up Service (25%)	Self-Delivery (5%)	Pick-Up/Self-Delivery (66%)
Annual Costs and Revenues			
Processing Costs:	$916,240	$410,058	$3,011,181
Residential Collection Costs:	$1,510,590	$2,147,510	$3,437,650
ICI Collection Costs:	$786,510	$255,750	$1,781,450
Total System Costs:	$3,213,340	$2,813,318	$8,230,281
Total System Cost per Tonne: (of Recyclables)	$335	$1,465	$263
Total Revenues:	$604,348	$120,880	$1,217,424
Total Net System Cost:	$2,608,992	$2,692,438	$7,012,857
Total Net System Cost per Tonne: (of Recyclables)	$272	$1,402	$224
Total Net System Cost per Tonne: (of Recyclables excluding ICI collection costs)	$190	$1,269	$167
Total Net System Cost per Tonne of All Wastes: (excluding ICI collection costs)	$36	$49	$105
Total Net System Cost per Household of All Wastes(3): (excluding ICI collection costs)	$58	$77	$166

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(1) Bracketed percentages indicate diversion rates of the Base Case recycling systems.

(2) Direct Comparisons of MaxRF with the other recycling systems are not valid without consideration of all costs. See Section 5.4 for cost comparison of recycling systems on an equal basis.

(3) Total solid wastes tonnage generated and households per CPFSA are provided in Table 1.

Table 3
Summary of Central Processing Facility Service Area Costs and Revenues - CPFSA #2

Base Recycling System(1):	A. Full Service	B. Minimum Service	C. MaxRF (Wet/Dry)(2)
Residential Component:	Roadside Collection (15%)	Drop-off Depot (3%)	Roadside Collection (60%)
ICI Component:	Pick-up Service (25%)	Self-Delivery (5%)	Pick-Up/Self-Delivery (66%)
Annual Costs and Revenues			
Processing Costs:	$965,170	$486,463	$3,296,723
Residential Collection Costs:	$1,256,730	$1,522,310	$2,568,630
ICI Collection Costs:	$790,870	$204,910	$1,788,270
Total System Costs:	$3,012,770	$2,213,683	$7,653,623
Total System Cost per Tonne: (of Recyclables)	$204	$751	$161
Total Revenues:	$936,728	$187,364	$1,850,318
Total Net System Cost:	$2,076,042	$2,026,319	$5,803,305
Total Net System Cost per Tonne: (of Recyclables)	$141	$688	$123
Total Net System Cost per Tonne: (of Recyclables excluding ICI collection costs)	$87	$618	$85
Total Net System Cost per Tonne of All Wastes: (excluding ICI collection costs)	$17	$24	$53
Total Net System Cost per Household of All Wastes(3): (excluding ICI collection costs)	$37	$52	$115

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(1) Bracketed percentages indicate diversion rates of the Base Case recycling systems.

(2) Direct Comparisons of MaxRF with the other recycling systems are not valid without consideration of all costs. See Section 5.4 for cost comparison of recycling systems on an equal basis.

(3) Total solid wastes tonnage generated and households per CPFSA are provided in Table 1.

Table 4
Summary of Central Processing Facility Service Area Costs and Revenues - CPFSA #3

Base Recycling System(1):	A. Full Service	B. Minimum Service	C. MaxRF (Wet/Dry)(2)
Residential Component:	Roadside Collection (15%)	Drop-off Depot (3%)	Roadside Collection (60%)
ICI Component:	Pick-up Service (25%)	Self-Delivery (5%)	Pick-Up/Self-Delivery (66%)
Annual Costs and Revenues			
Processing Costs:	$1,252,967	$503,533	$6,895,432
Residential Collection Costs:	$2,231,210	$3,105,750	$4,817,440
ICI Collection Costs:	$1,388,640	$359,250	$3,582,160
Total System Costs:	$4,872,817	$3,968,533	$15,295,032
Total System Cost per Tonne: (of Recyclables)	$171	$695	$169
Total Revenues:	$1,841,200	$368,236	$3,536,499
Total Net System Cost:	$3,031,617	$3,600,297	$11,758,533
Total Net System Cost per Tonne: (of Recyclables)	$106	$630	$131
Total Net System Cost per Tonne: (of Recyclables excluding ICI collection costs)	$58	$567	$91
Total Net System Cost per Tonne of All Wastes: (excluding ICI collection costs)	$11	$23	$57
Total Net System Cost per Household of All Wastes(3): (excluding ICI collection costs)	$26	$52	$131

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(1) Bracketed percentages indicate diversion rates of the Base Case recycling systems.

(2) Direct Comparisons of MaxRF with the other recycling systems are not valid without consideration of all costs. See Section 5.4 for cost comparison of recycling systems on an equal basis.

(3) Total solid wastes tonnage generated and households per CPFSA are provided in Table 1.

Table 5
Summary of Central Processing Facility Service Area Costs and Revenues - CPFSA #4

Base Recycling System(1):	A. Full Service	B. Minimum Service	C. MaxRF (Wet/Dry)(2)
Residential Component:	Roadside Collection (15%)	Drop-off Depot (3%)	Roadside Collection (60%)
ICI Component:	Pick-up Service (25%)	Self-Delivery (5%)	Pick-Up/Self-Delivery (66%)
Annual Costs and Revenues			
Processing Costs:	$1,036,064	$486,463	$4,378,065
Residential Collection Costs:	$1,939,630	$2,832,630	$3,754,090
ICI Collection Costs:	$1,093,240	$278,530	$2,641,230
Total System Costs:	$4,068,934	$3,597,623	$10,773,385
Total System Cost per Tonne: (of Recyclables)	$200	$882	$170
Total Revenues:	$1,330,572	$266,104	$2,490,611
Total Net System Cost:	$2,738,362	$3,331,519	$8,282,774
Total Net System Cost per Tonne: (of Recyclables)	$134	$817	$131
Total Net System Cost per Tonne: (of Recyclables excluding ICI collection costs)	$81	$749	$89
Total Net System Cost per Tonne of All Wastes: (excluding ICI collection costs)	$16	$31	$57
Total Net System Cost per Household of All Wastes(3): (excluding ICI collection costs)	$28	$52	$95

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(1) Bracketed percentages indicate diversion rates of the Base Case recycling systems.

(2) Direct Comparisons of MaxRF with the other recycling systems are not valid without consideration of all costs. See Section 5.4 for cost comparison of recycling systems on an equal basis.

(3) Total solid wastes tonnage generated and households per CPFSA are provided in Table 1.

Table 6
Summary of Central Processing Facility Service Area Costs and Revenues - CPFSA #5

Base Recycling System(1):	A. Full Service	B. Minimum Servicc	C. MaxRF (Wet/Dry)(2)
Residential Component:	Roadside Collection (15%)	Drop-off Depot (3%)	Roadside Collection (60%)
ICI Component:	Pick-up Service (25%)	Self-Delivery (5%)	Pick-Up/Self-Delivery (66%)
Annual Costs and Revenues			
Processing Costs:	$1,053,029	$486,463	$6,675,946
Residential Collection Costs:	$2,493,580	$3,077,150	$6,038,810
ICI Collection Costs:	$1,486,980	$490,460	$4,740,980
Total System Costs:	$5,033,589	$4,054,073	$17,455,736
Total System Cost per Tonne: (of Recyclables)	$230	$926	$255
Total Revenues:	$1,420,856	$284,136	$2,690,975
Total Net System Cost:	$3,612,733	$3,769,937	$14,764,761
Total Net System Cost per Tonne: (of Recyclables)	$165	$861	$216
Total Net System Cost per Tonne: (of Recyclables excluding ICI collection costs)	$97	$749	$147
Total Net System Cost per Tonne of All Wastes: (excluding ICI collection costs)	$20	$30	$93
Total Net System Cost per Household of All Wastes(3): (excluding ICI collection costs)	$38	$59	$180

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(1) Bracketed percentages indicate diversion rates of the Base Case recycling systems.

(2) Direct Comparisons of MaxRF with the other recycling systems are not valid without consideration of all costs. See Section 5.4 for cost comparison of recycling systems on an equal basis.

(3) Total solid wastes tonnage generated and households per CPFSA are provided in Table 1.

o **The impacts of the Sensitivity Tests on recycling systems costs and revenues**

The Sensitivity Tests were designed to encompass the range of possibilities which would affect the costs and effectiveness of the recycling system options, as applied to the CPFSA's. Variations from the Base Case in the vehicles used for recyclables collection, collection service levels, the materials to be recycled, diversion rates, and market prices were predicated on experience attained locally and elsewhere.

- Costs of recyclables collection varied more when comparing systems which require more than one person operation, than to differences in the operations or costs of other vehicle configurations.

- While reduced collection services will reduce system costs, waste diversion and revenue levels will also be reduced, thus reducing the effectiveness of the recycling system.

- In general residential roadside collections cost do not vary in proportion to the volume of recyclable materials diverted, high or low, by a given system. The per tonne collection costs vary more according to the altered diversion rates than to the marginal affects on the total costs of collection. This highlights an obvious economies incentive to improve the diversion rates of recycling programs.

- Adding recyclable materials not presently included in New Brunswick recycling programs to the Base Case set will not greatly affect collection costs, if they are co-collected along with the existing recyclables. However, given that the net market prices for most of these materials from New Brunswick are low at present, they will not effect revenues much either.

- Prices varying by as much or more than 20 % can be expected in the apparent inconsistent recyclable materials marketplace.

- **Comparative analysis of the Base Case Recycling Systems as integral parts of the "Bottom Line" of costs and revenues of entire Regional Solid Waste Management Systems**

Tables 2 to 6 above provide a summary of Base Case recycling systems financial information provided by this study. However, some essential cost information were not available to make valid "bottom line" comparisons of the Full Service and Minimum Service recycling systems with the MaxRF (Wet-Dry) Service recycling systems on an equal basis.

The Full and Minimum Service recycling systems residential and ICI collection costs include only the collection of recyclable materials for delivery to the CPF's. These recycling systems require operation of a parallel recyclables collection service independent of the collection of the remaining non-recyclable solid wastes for delivery to a disposal site. In addition, relatively small amounts of residual non-recyclable wastes generated at the CPF's of about 5% of the recyclable materials, will require transport from the CPF to the disposal site.

The Base Case Full Service roadside collection recycling systems divert 15% of recyclable materials from the residential waste stream, so the remaining 85% of non-recycled solid wastes must be collected by a conventional solid waste collection system for disposal. Base Case Minimum Service drop-off depots recycling systems divert 3% of the recyclable materials from the residential waste stream, so the remaining 97% of non-recycled solid waste must be otherwise collected for disposal. Similarly ICI non-recyclable solid wastes would require separate delivery to a disposal site.

The MaxRF (wet-dry) Service recycling system residential and ICI collection are provided by single collection system services, which deliver all wastes to the MaxRF plant for processing. The process residuals and non-recyclable and non-compostable solid waste (ie. approximately 40% of the residential waste stream), are transported on to a disposal site. Similarly, ICI wastes are collected, processed and the residuals transported on for disposal in one system.

Three essential cost elements are therefore missing from the Base Case recycling system per CPFSA **Tables** 2 to 6, which are required to make valid comparisons among the three alternate recycling systems. They are:

1. the non-recycled solid wastes (ie. garbage) collection costs required by the Full Service and Minimum Service recycling systems;
2. the transport costs of transferring process residuals and non-recyclable wastes from the CPF's or MaxRF's to a regional disposal site; and
3. the solid waste disposal costs of non-recycled wastes.

These three cost elements are presently unknown to many of the Solid Waste Management Regions, principally due to the lack of a selected disposal method and/or site location. However, data were available from the Westmorland/Albert Region for use as an example for other solid waste management regions to perform their own evaluations, as data becomes available. **Table 7** presents an exemplary comparison of annual costs of recycling system options applicable to the Westmorland/Albert Region of CPFSA4.

6.0 FEASIBILITY OF A CENTRAL MARKETING AGENCY FOR RECYCLABLES

The concept of a single agency holding sole responsibility for the recycling promotion and materials marketing of all five CPFSA's was reviewed.

- o **Evaluation of appropriateness and efficiencies of various central marketing structures**

An organization charged with the marketing responsibility must have as its objective the optimization of revenues with the goal of reducing the costs of recycling for the ratepayers of each region. Consequently the marketing body should ideally be an agent of the solid waste management regions and report to them through their CPFSA and/or SWM Region.

- o **Feasibility of a central marketing agency for New Brunswick**

Compared to large jurisdictions elsewhere in North America, the solid waste management regions of New Brunswick all serve a relatively small population base. This means that each region or service area can offer relatively small amounts of recycled materials on the market. The concept of joint central marketing will allow

Table 7
Comparison of Annual Costs of Recycling System Options

	CPFSA	SWM Region
Number/Name:	*4*	*Westmorland / Albert*
Total Solid Waste (Tonnes):	*99,844*	*88,039*
Residential Solid Waste (Tonnes):	*45,743*	*38,737*
Total Households:	*59,205*	*48,580*

Recycling Systems:	**Full Service**	**Minimum Service**	**MaxRF Service**
Residential:	*Roadside Collection*	*Drop-off Depots*	*Roadside Collection*
ICI:	*Pick-up*	*Self-Delivery*	*Pick-up/Self Delivery*
CPFSA Information:			
1. Residential Diversion Rates:	*15%*	*3%*	*60%*
2. Residential Recyclables Tonnage:	*6,861*	*1,372*	*27,409*
3. Total Recyclables Tonnage:	*20,387*	*4,077*	*63,365*
4. Total Processing Cost:	*$1,036,064*	*$486,463*	*$6,695,946*
5. Residential Collection Cost:	*$1,939,630*	*$2,832,630*	*$3,754,090*
6. ICI Collection Cost:	*$1,093,240*	*$278,530*	*$2,641,230*
7. Total Revenue:	*$1,330,572*	*$266,104*	*$2,490,611*
8. Total Net System Cost:	*$2,738,362*	*$3,331,519*	*$8,282,774*
9. Total Net System Cost per Tonne: (of Recyclables)	*$134*	*$817*	*$131*
10. Total Net System Cost per Tonne of All Waste (excluding ICI collection costs):	*$16*	*$31*	*$57*
11. Processing Plant Capital Funding per Tonne of All Waste:	*$2*	*$1*	*$7*
Solid Waste Management Information:			
12. Total Net Recycling System Cost per Household (including capital funding and excluding ICI collection costs):	*$24*	*$51*	*$84*
13. Remaining Residential Solid Waste Collection Cost per Tonne:	*$49*	*$49*	*$0*
14. Residual Wastes Transportation Cost per Tonne:	*$0*	*$0*	*$3*
15. Landfill Disposal Cost per Tonne:	*$28*	*$30*	*$18*
16. Other Solid Waste Operations Costs per Household:	*$61*	*$63*	*$17*
17. Total Solid Waste Management System Cost per Household:	*$85*	*$114*	*$101*

more stable and longer term market arrangements, improved commodity prices, and could reduce transportation and inventory costs. In addition, considerable administrative and promotional cost savings would be realized by having one central operation versus five or more independent marketing and promotion operations.

1.0 INTRODUCTION

1.0 INTRODUCTION

1.1 Background

The New Brunswick Department of the Environment has been involved in the process of implementing comprehensive province-wide solid waste management programs. All of the 12 solid waste management regions have now established regional committees and are in varying stages of the planning process. The objective of the Province is to construct regional solid waste management systems to replace the existing numerous local dump sites located throughout the regions. Two regions, Fredericton and Nepisiguit/Chaleur, have established Solid Waste Management Commissions and are engaged in operating regional sanitary landfill sites.

As part of the Province's commitment to support the implementation of effective state-of-the-art waste disposal technologies to protect the environment at reasonable costs to the public, the Department of the Environment is working with regional committees to assess waste disposal and reduction alternatives. New Brunswick has set a goal of 50% reduction of waste by the year 2000. One of the waste reduction alternatives is the recycling of waste materials for use as an input material to another product, or as a fuel. Many of the solid waste management regional committees have expressed interest in their region participating in recycling programs. Some have already studied the prospects of recycling within their region. Only the Fredericton Solid Waste Commission to date has implemented a recycling program, and it serves only the urban (City of Fredericton and Town of Oromocto) portions of the Fredericton Solid Waste Region.

This study was commissioned by the Province in recognition that the processing facilities required for recycled materials constitute inordinately high capital costs for plant and equipment. However, recycling programs reduce the waste volumes required for disposal, and therefore can defer capital costs of providing new sanitary landfill disposal sites by extending the design life of disposal facilities. This in turn will reduce the operating cost of the conventional disposal systems.

Recycling also provides an opportunity for the public to be involved in waste reduction in a personal way and has had widespread support from the public.

Regardless of the apparent benefits of recycling programs in reducing the volume waste materials requiring disposal and from reduction in consumption of non-renewable and managed resources, some solid waste regional committees may find the costs of recycling too high. Others may implement a recycling program but for the same reason not retain it. In hopes to avoid this possibility the Province has directed this study to look at various recycling system options, and to consider the establishment of larger service areas to be served by Central Processing Facilities (CPF's) or Maximized (Wet-Dry) Recycling Facilities (MaxRF's) to gain potential economies of scale, and reduce recycling costs to the respective member Solid Waste Management regions.

Compared to large jurisdictions elsewhere in North America, the solid waste management regions of New Brunswick all serve a relatively small population base. This means that each region can offer relatively small amounts of recycled materials on the market. The concept of joint marketing may allow more stable and longer term market arrangements to be considered. In this regard a marketing agency may be an appropriate vehicle to provide a focus for the marketing of recyclable materials produced in New Brunswick.

1.2 Study Approach

The principal objective of this study has been to establish the options available for recycling and to determine their respective collection and processing cost and revenue potential, as applicable to the Province of New Brunswick. To meet this objective the study has focused on large-scale regionally integrated systems to achieve economies of scale in processing of recyclables at CPF and MaxRF plants and collection systems. The role of small-scale local recycling programs has been addressed within the context of implementation of large-scale recycling approaches.

The first major undertaking of the study involved researching existing documentation and surveying participants for data and information necessary to determine:

1. The population and households distributed throughout New Brunswick;

2. The total solid wastes generated throughout New Brunswick;

3. The composition of the residential and industrial, commercial and institutional (ICI) waste streams;

4. The range of integrated large scale recycling collection and processing system options;

5. Existing local participants and recycling programs in New Brunswick;

6. The range of recovery, participation and diversion rates associated with the recycling program options; and

7. The markets and prices available to New Brunswick recyclable materials.

The data and information gathered were collected and assessed for application throughout the subsequent analyses.

The analyses performed for this study and reported within this text include:

1. The preliminary process and plant layout design, and capital and operating cost estimates of four CPF and two MaxRF Plants of varied recyclable materials throughput capacities;

2. An analysis to select from four Central Processing Facilities Service Area (CPFSA) Scenarios the most cost efficient sized areas to serve the province with recycling processing plants given their plant scale economies versus their line haul transport costs;

3. An analysis of residential and ICI recycling collection system options costs estimated for each CPFSA of the province;

4. A base case and sensitivity analysis of recycling collection and processing costs and recyclables material revenues estimated for a range of postulated combinations of circumstances representing the range of possibilities acknowledged by the Study Team from the information research of recycling and participant interviews survey; and

5. An assessment of the financial and operational merits of establishing a marketing agency to serve all CPFSA's of the province, as opposed to each CPFSA doing their own marketing.

2.0 DATA CAPTURE AND RESEARCH

2.0 DATA CAPTURE AND RESEARCH

Recycling of waste materials as a solid waste management alternative is a very dynamic and growing industry in most Western World nations. The Provinces of Canada recently joined together in a target pact to reduce waste disposal by 50% by year 2000. Similar goals have been set elsewhere.

In New Brunswick achieving this recycling goal from its present status is a formidable task to say the least. Most of the Province still dispose wastes in rural dump sites which have minimal environmental control. Engineered environmentally sound landfill sites are available only in Fredericton and Nepisiguit/Chaleur regions. The remaining regions of the Province have assessed, are in the process, or are about to, assess their waste management strategies.

Due to expedience the focus of these waste management studies has been principally on waste disposal alternatives and site selection. Only recently have the options of recycling and composting received balanced attention, as potential supplementary means to handling wastes, by diverting a portion of the waste stream away from the need for disposal. The most obvious and commonly cited benefit of such an approach in technical studies has been the reduction of disposal requirements, which leads to the extension of the operating life of disposal facilities and reduces the need to find new disposal sites in the future. This has been especially the case in highly urbanized areas, where the cost and availability of land is at a premium. But recycling programs have been shown to add to costs of waste management. So while in New Brunswick the problems of finding socially acceptable (ie. "not-in-my-backyard") disposal sites are perhaps as contentious as anywhere else, the cost and availability of land has not been the driving economic force supporting investment in recycling. Therefore, the appeal of recycling in New Brunswick, as elsewhere, has developed as much or more from the social preference to reduce the long-term land use and perceived environmental risks of disposal sites, as well as to reduce the end consumption of potentially reusable natural resources.

In North America comprehensive large-scale recycling programs are in their infancy. With the exceptions of scrap metals and some oil recycling from industrial and commercial sources, and some newspaper recycling and returnable beverage containers from residents, most recycling programs have been established within the last 3 to 5 years. As such, most programs have been initiated and proceeded on a "learn-as-you-go" basis. Many still are. Only very recently has information from a limited number of operations been published, and a base of performance data and experience been made available. Therefore, this study required a concerted survey effort of operations to get first-hand information from operators with sufficient experience in a range of program approaches. This information was used to develop the analyses of recycling system approaches and diversion scenarios applied later in this study.

This chapter provides a review of the waste generation data base available and developed for this study. It provides an inventory and summary status of existing recycling systems in New Brunswick, and addresses their future status should the large-scale recycling systems analyzed in this study be implemented. It also provides a summary of the results of the primary and secondary research into recycling system approaches, their relative performance and characteristics, as well as the local and out-of-province markets and prices for recyclables.

2.1 Waste Generation Data

In order to determine the total waste generated in the province, data were obtained from the regional waste audit studies and actual disposal data from two regional facilities. At the time of this study, seven of the twelve solid waste management regions in New Brunswick had completed waste audits and assessments of technical alternatives. The waste audits were reviewed to obtain information regarding the sources and quantities of waste within the regions, as well as any information on existing recycling operations.

The waste audits identify industrial, commercial and institutional (ICI) and residential waste streams. The residential waste stream in the regions represented a range of between 32 to 58% of the total waste stream. The quantities of waste generated were calculated using regional population and commonly broken down into urban and rural waste generation rates.

The information on existing recycling operations in the waste audits was limited. Some information was provided on the types of materials collected for recycling in the region. Very little was provided on the quantities recycled. The Fredericton Solid Waste Commission has operated a residential Blue Box program and commercial paper pick-up program for about two years, which provided the best local experience and information from within the Province. However, it became quite apparent that information from other programs in Canada and the U.S.A. would be required to properly address the range of programs and their diversion levels. This research work is reported in **Section 2.3**, below.

The Nepisiguit-Chaleur and Fredericton Solid Waste Management (SWM) regions are presently operating regional waste disposal facilities. These facilities charge a tipping fee, so all waste entering the landfill is weighed and recorded.

There are three regions that have not yet completed waste audits. The wastes generated in these regions were calculated by multiplying the regional population by the average of provincial ICI and residential waste generation rates obtain from the audits and weight scale inventories.

The twelve SWM regions do not cover the entire province. Some areas and municipalities in the Restigouche County, Queens County, York County and Sunbury County have not yet been assigned to a SWM region. The wastes generated in these areas were calculated based on their population and estimated waste generation rates and added to the most appropriate region.

Table 2.1 presents the estimates of ICI and residential waste data in each of the twelve SWM regions. **Figure 2.1** illustrates the twelve SWM regions of New Brunswick, as they presently exist. The shaded areas indicate the remaining parts of the Province not allocated to a SWM region.

2.2 Existing Recycling Operations in New Brunswick

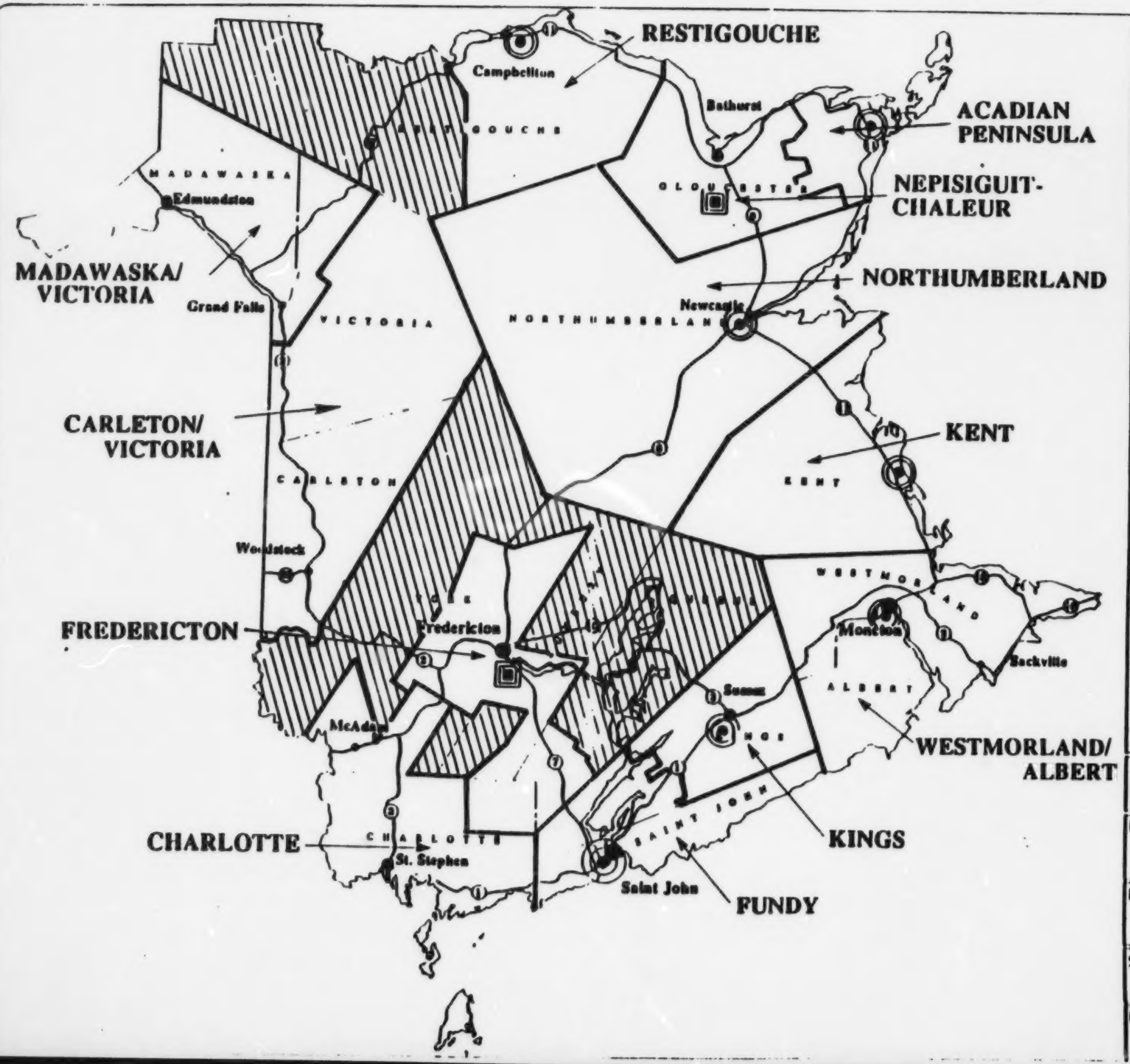
With the recent growth in environmental awareness, the media attention given to solid waste issues, and the availability of government dollars for "green" or "eco" entrepreneurs, the business of recycling has grown considerably. In fact, from discussions with local recyclers and solid waste project managers and through information obtained in regional waste audits, it was determined that in January, 1991 there were over 90 recycling related operations in existence in the province. This section presents an overview of these operations. Because of the large

Table 2.1
New Brunswick Waste Generation

Solid Waste Regions	Residential Tonnes/Year		Industrial, Commercial, Institutional (ICI) Tonnes/Year	
Restigouche	10,679	(1,963)*	9,469	(1,741)*
Madawaska/Victoria**	13,903		9,952	
Carleton/Victoria**	12,512	(547)*	8,957	(392)*
Fredericton	33,805	(7,569)*	27,872	(6,240)*
Charlotte**	9,090		6,505	
Fundy	55,699	(184)*	59,025	(195)*
Kings	5,839	(1,014)*	4,635	(805)*
Westmorland/Albert	38,737		49,302	
Kent	7,006		4,799	
Northumberland	13,088		26,960	
Acadian Peninsula	16,078		11,509	
Nepisiguit/Chaleur	11,972		8,546	
TOTAL	**228,408**	**(239,685)***	**227,531**	**(236,904)***

* - includes areas not presently included in the region

** Note: Waste generation estimates for Madawaska/Victoria, Carleton/Victoria and Charlotte regions are preliminary, as waste audit estimates were unavailable at the time of this study.


RESTIGOUCHE
Campbellton
Bathurst
ACADIAN PENINSULA
NEPISIGUIT-CHALEUR
GLOUCESTER
MADAWASKA
Edmundston
MADAWASKA/VICTORIA
Grand Falls
VICTORIA
NORTHUMBERLAND
Newcastle
CARLETON/VICTORIA
CARLETON
KENT
Woodstock
YORK
QUEENS
WESTMORLAND
Moncton
Sackville
FREDERICTON
Fredericton
Sussex
ALBERT
KINGS
WESTMORLAND/ALBERT
McAdam
SAINT JOHN
CHARLOTTE
St. Stephen
Saint John
FUNDY

Legend

◎ Centre of Generation Hypothetical Disposal Site

▣ Landfill Site

▨ Area not Included in SWM Region

FIGURE 2.1

FGA FIANDER-GOOD ASSOCIATES LTD.

Project Title: NB RECYCLING PLAN

Drawing Title: EXISTING SWM REGIONS

Scale: not to scale	Date: June, 1991
Drawn by: JTGB	Job No: 612-04

number of operations and diversity of activities, they were classified into five categories. These operations were, for the purposes of this study, classified as:

- Broker/processors
- Non-profit recyclers
- End-users
- Commercial recyclers
- Large non-profit recyclers

2.2.1 Brokers/Processors

Brokers and processors of recyclable materials are primarily involved in the buying and selling of commodities. In some cases, brokers will process or refine the product by removing contaminants or baling for economical transport and storage prior to selling the commodity. Typically, brokers/processors deal in a limited number of high grade materials and rely on large volumes which usually originate from the commercial sector. Operations of broker/processors are guided by a "bottomline", and are therefore rarely involved in residential recycling activities.

It was determined that there are 72 broker/processing operations in the province, including Cyclomet in Scoudouc, bottle exchanges and scrap metal dealers. The distribution of their operations, by region, is presented in **Table 2.2**.

2.2.2 Non-Profit Recyclers

Non-profit recyclers may be considered to be at the other end of the recycling spectrum from broker/processors. They collect or receive recyclable materials and sell them using volunteers. They are usually involved in recycling as a means of fund raising and/or promoting conservation and environmental awareness among group members and the local community. Examples of non-profit recyclers include: schools, scouts/guides, church groups, local environmental activists, service clubs, etc. Because non-profit recyclers are so varied and typically operate on an irregular basis, they are impossible to quantify.

TABLE 2.2

EXISTING RECYCLING OPERATIONS IN NEW BRUNSWICK

REGION	BROKER/ PROCESSOR	COMMERCIAL RECYCLERS	LARGE NON-PROFIT RECYCLERS	END-USER
Acadian Peninsula	5	0	0	0
Carleton	2	0	1	0
Charlotte/Victoria	2	0	0	1
Fredericton	6	0	1	0
Fundy	7	1	0	1
Kent	3	1	0	0
Kings	3	0	1	1
Madawaska/Victoria	7	0	0	1
Nepisiguit-Chaleur	6	0	0	2
Northumberland	6	1	0	0
Restigouche	7	0	0	0
Westmorland/Albert	18	2	0	4
TOTAL	72	5	3	10

2.2.3 End-Users

End-users are those industries that utilize already manufactured products, that would otherwise be discarded, in the production of new materials. Examples of end-users include Stone-Consolidated, Frasers (Edmundston), Lake Utopia Ltd., Consumers Glass and Inland Oil. Like broker/processors, from whom they often buy, end-users make many of their decisions on a cost basis. In oversimplified terms: if purchasing a recycled feed-stock for their process does not impact product quality and is cheaper overall than virgin feed-stock, chances are they will buy it.

In the survey of recycling operations, it was determined that there are ten end-users of recyclable materials in the province. The distribution of end-users, by region, is presented in **Table 2.2**.

2.2.4 Commercial Recyclers

Commercial recyclers actively collect, receive and process recyclable commodities for sale to a broker or end-user on a permanent basis using paid staff. They utilize both the residential and/or ICI generators to contribute to their operations and usually accept a wider range of commodities than brokers.

Commercial recycling operations are guided by "the bottom line", but may accept materials knowing that the price they will receive from the broker or end-user will be less than the cost of processing and shipping. In such cases, they may accept materials, store them, and wait for the markets to improve. Commercial recyclers operate on a very thin margin and are sometimes supported through capital and/or operating grants. They are extremely susceptible to market fluctuations, as evidenced by the number of operations that have started up in recent months only to shut down shortly thereafter. Those who have planned their operations carefully and secured markets for their recyclables tend to fare better and are able to sustain operations in the longer term.

Examples of commercial recyclers include: Saint John Recycling in Saint John and Donald Brun Recycling in Scoudouc. Based on the definition used in this study, it was determined that there are only five commercial recycling operations in the province. The distribution of commercial recycling operations, by region, is presented in **Table 2.2**.

2.2.5 Large Non-Profit Recyclers

Large non-profit recyclers actively collect and/or accept recyclabes which they process for sale to a broker or end-user. They accept materials from residential and/or ICI generators and accept a wide range of recyclables.

Their operations are typically subsidized but they do work, to a degree, toward a "bottom line". Like their commercial counterparts they may accept materials knowing the price they will receive may be less than the cost of processing and shipping. Examples of large non-profit recyclers include: SWC Recycling in Fredericton, Sussex Recycling in Sussex and Carleton County Recycling (The Clearinghouse Project) in Woodstock.

Two systems, Fredericton and Woodstock, operate widespread "blue-box" residential collection programs. The Fredericton operation also provides some commercial papers pick-up services. Sussex Recycling provides collection to commercial generators.

The commodities processed by the large non-profit recycling operations include: plastic, old newspaper (ONP), glass, aluminum, paper, old corrugated cardboard (OCC), and in one instance, egg cartons. **Table 2.3** lists the eight commercial and large non-profit recyclers in the province, the region in which they are located, commodities being recycled, and the extent of collection services.

The following profiles briefly describe the commercial and large non-profit recycling operations, as were operating at the time of the study research survey in January, 1991. A complete listing of the contact names, addresses and phone numbers is provided in **Appendix D**.

1. Carleton County Recycling

Carleton County Recycling - Woodstock, New Brunswick
Manager: George Peabody

TABLE 2.3

COMMERCIAL AND LARGE NON-PROFIT RECYCLERS IN NEW BRUNSWICK

Region/ Recycler	COMMODITIES RECYCLED							COLLECTION SERVICES	
	Plastic	ONP	OCC	Glass	Paper	Aluminum	Other	Residential	ICI
CARLETON									
Carleton County Recyclers (NP)	X	X	(1)	X	X	X	(2)	X	L
FREDERICTON									
S.W.C. Recycling (NP)	X	X	X	X	X	X		X	X
FUNDY									
Saint John Recycling (C)	X	X	X	X	X	X	(3)	D	X
KENT									
Gallant's Collection and Recycling (C)	X	X	X	X	X	X		L	L
KINGS									
Sussex Recycling (NP)	X	X	X	X	X	X		D	X
NORTHUMBERLAND									
Miramichi Recycling (C)			X	X		X		D	D
WESTMORLAND/ALBERT									
Donald Brun Recycling (C)								X	X
Juniper Recycling (C)		X	X	X	X	X		D	D

1 OCC is being recycled by Woodstock Recycling located in the same facility as Carleton County Recyclers
2 Egg cartons are being recycled
3 Tin is being recycled
L Limited collection services are offered
D Depot services are offered
NP Large Non-Profit Recycler
C Commercial Recycler

Carleton County Recycling is a non-profit recycling operation that provides full blue-box curbside collection to 1,250 households in the town of Woodstock. Collection is provided on the same day as regular garbage pick-up and a one-ton flat bed truck has been retrofitted to allow curbside sorting of the recyclables. Approximately 40% of the town's households are serviced on one day and the balance the next. Based on preliminary data, operators estimate that the collection vehicle makes 500 to 600 stops in the two-day period. Collection is provided to the recycling operations as an 'in-kind' contribution from Carnies Hygienic.

Materials processing is provided by developmentally disabled adult workers, and the equipment, which includes a baler and forklift, and warehouse space is rented from Carnies Hygienic.

A local interest group, the Clearinghouse Environmental Group, has assisted the manager in promoting the program. As part of the program launching activities, flyers were prepared, columns appeared in the local paper, the manager sat in on several radio talk shows, and spoke to many school children and service clubs.

At this point, the program appears to be well accepted and is expected to operate for the next three years under financing from the Environmental Partners Fund, revenues of the sale of materials and "in-kind" contributions from Carnies Hygienic, the Sheltered Workshop and the Clearinghouse Group.

2. SWC Recycling

SWC Recycling - Fredericton, New Brunswick
Manager: Peter Theriault

SWC Recycling is a division of the Fredericton Regional Solid Waste Commission. SWC Recycling processes the recyclables collected in the blue-box, multi-material curbside program in the City of Fredericton and Town of Oromocto. They collect and process office waste paper from within the region, and recover old corrugated cardboard (OCC).

The residential recycling program serves all households in the two municipalities. Materials are picked up on a weekly basis by a collector contracted by the municipality and are processed by SWC. In total, six commodities are collected, they include: newspaper, clear glass, PET plastic, rigid plastic, film plastic and aluminum cans. From discussions with the city's recycling co-ordinator, it was determined that the program's participation rate was in the order of 60%.

In addition to the residential processing, SWC is also involved in commercial sector recycling. OCC is recovered from the working face of the landfill; it is also deposited at the recycling facility by local collectors. At the recycling facility, the cardboard is cleaned, baled and stored for eventual shipment. Fine papers from offices, are both collected and processed by SWC Recycling. Paper is collected from offices and institutions by staff of the recycling facility, it is then sorted, baled and stored for shipment.

It was determined that approximately 2,700 tonnes of material were processed by SWC Recycling in 1989. Diversion of recyclable materials was in the order of 11% of the residential waste stream.

3. Saint John Recycling

Saint John Recycling - Saint John, New Brunswick
Manager: John Whipple

Saint John Recycling was recently sold to a Montreal interest. Company restructuring is now underway and major expansion on the commercial side of the operations is planned. At the time of the survey the company indicated that they would like to expand their residential operations and had ordered "igloo" type depots.

A wide range of commodities are accepted at Saint John Recycling, but OCC, which is processed at the rate of approximately 150 tonnes per month, represents approximately half of their throughput. It is also estimated that approximately 25 tonnes of computer printout and 36 tonnes of office paper are processed per month. The company currently employs seven people and they hope to install a conveyor for paper sorting, which will see the staff complement increase by four.

4. Gallants Collection and Recycling

Galloway - Kent County, New Brunswick
Manager: Michael Gallant

Gallants Collection and Recycling is located in Galloway between Buctouche and Rexton, and has been operating approximately five months. The operation accepts a wide range of commodities from residential and ICI generators. They also provide limited collection services for pick up of paper and OCC at area schools and businesses. Due to their short operating record, quantitative information regarding tonnage was not available.

The company employs three staff on a full-time basis and hopes to eventually build their own plant.

5. Sussex Recycling

Sussex Recycling - Sussex, New Brunswick
Manager: Norma Harris

Sussex Recycling is a non-profit operation that provides full collection and recycling services to ICI generators and recycling depot services to residential generators. Collection is provided to commercial generators and the manager indicated that the existing collection vehicle is working at capacity. Materials are also obtained from a depot situated at the Sussex Waste Transfer Station and from drop-offs at the processing facility.

Materials processing is provided by seven full time and two part-time staff, half of which are developmentally disabled. Sussex Recycling also owns a baler for processing all their materials. Based on data collected in the first nine months of operation, it is estimated that over 800 tonnes of materials are processed annually. Ms. Harris estimates that approximately 80% of the materials are from the ICI sector and the balance is from the residential sector. **Table 2.4** presents the quantities of materials processed by Sussex Recycling.

Promotion of the recycling program has been provided by the Town of Sussex and the Kings County Solid Waste Committee. The program is well accepted and the manager would like to expand operations, but funding to do so is not available at present. Operations financing is provided from the sale of materials and funding from the Environmental Partners Fund.

TABLE 2.4

COMMODITIES PROCESSED AT SUSSEX RECYCLING

COMMODITY	QUANTITY*	PERCENT OF TOTAL
OCC	472	57.0%
Glass	80	9.7%
Aluminum	4	.5%
Plastic Film	6	.8%
ONP	236	29.0%
Fine paper	25	3.0%
TOTAL	823	100.0%

* tonnes/year

6. Miramichi Recycling

Miramichi Recycling - Chatham, New Brunswick
Manager: Clarence Morris

Initially, Miramichi Recycling was providing collection and processing of recyclables to residences and businesses in the Chatham/Newcastle area, as well as the surrounding communities. Commodities handled included OCC, paper, glass and aluminum. However, unstable markets, particularly with OCC, financial pressures and low participation rates combined to force Miramichi Recycling to cut back operations drastically. Collection services are no longer provided, and now a depot system of sorts is operated. Glass, aluminum and paper are accepted and processed on an intermittent basis.

7. Donald Brun Recycling (Shediac Pallet)

Donald Brun Recycling - Scoudouc, New Brunswick
Manager: Donald Brun

Donald Brun Recycling provides collection services to approximately 1,500 homes scattered throughout Moncton, Riverview, Dieppe, Scoudouc and Haute-Aboujagane. Both glass and aluminum are collected. Glass is processed by this facility and the aluminum is processed by Juniper Recycling. Mr. Brun has indicated that residential recycling is not economically viable and will stop collection, if financial assistance from municipalities in the region is not forthcoming.

In addition to the residential program, Mr. Brun also collects glass from commercial generators and serves as a broker for Consumers Glass. Mr. Brun indicated that these activities are much more stable and financially rewarding.

8. Juniper Recycling

Juniper Recycling - Moncton, New Brunswick
Contact: Pat Steeves

Juniper Recycling provides a recycling depot and processing operation for residential and ICI generators in the Greater Moncton area. Five commodities are accepted including: OCC, aluminum, glass, ONP and fine paper. Ms. Steeves indicated that most depot users are ICI generators rather than individual homeowners. Recyclables are also delivered by the City of Moncton from bins at the Moncton landfill.

Juniper Recycling is also associated with two other recycling/ broker companies: Eastern Shredding and Tri-Province Enterprises.

2.3 Implementation Considerations

Implementing large-scale recycling systems with central processing facilities with capacities to handle large volumes of various recyclable commodities may impact local recycling initiatives. Therefore the various approaches for integrating existing operations with the large systems should be considered. The following identifies factors to consider when examining options for the implementation of central processing facility (CPF) recycling systems, which could include integration of existing operations.

In view of the various activities undertaken by the brokers, end-users, non-profit recyclers, commercial, and large non-profit recycling operations, it is suggested that the commercial recyclers will be impacted by the establishment of large-scale recycling CPF's more than the other recycling operations. The end-users, brokers, and non-profit recyclers will be minimally, impacted. In fact the impact on end-users will likely be positive. As a result of CPF's being established, it is expected that end-users may be able to buy larger volumes of recyclable materials that are of a consistently better grade, from fewer sellers.

In the case of non-profit organizations, it is suggested that they may lose some materials to CPF's. However, with the proposed Beverage Containers Legislation they may gain a ready-made market for their "Bottle Drives" to purchase their recyclables. This could be extended to aluminum cans and presently non-returnable pop bottles.

It is suggested that brokers will not be impacted significantly by the establishment of CPF's. This is because they have dealt with materials not usually collected in organized recycling programs, such as beer bottles, car batteries, scrap metals and white goods. The brokers dealing exclusively in cardboard may lose a portion, if not all of their market share, if CPF's are aggressive in obtaining commodities from the ICI sector. However, as awareness of waste management issues are brought to light by regionalized recycling facilities, brokers may benefit from the public and ICI sector demands to recycle materials not handled by CPF's.

As stated earlier, it is expected that the small, less viable commercial recyclers will be most negatively impacted by the establishment of CPF's. If they co-exist they will be competing for the same markets.

Therefore it will be necessary to consider if and how the existing facilities should be incorporated into the operation of CPF recycling system.

2.3.1 Impact of CPF's on Existing Recyclers

There are three basic implementation options to consider upon establishment of CPF's regarding the impact on local commercial recycling operations.

1) Full integration of existing recycling operations into regional systems, where existing facilities may take the place of a new CPF.

2) No integration of existing recycling operations into regional CPF systems, where a new CPF is established without incorporating existing operations to any degree.

3) Partial integration of existing recycling operations into regional CPF systems, where a new CPF is established and equipment, services or labour from existing operations are utilized.

Determining which option should be selected requires evaluation the capabilities of the existing operations and the requirements of the CPF. The following lists key factors that should be identified and confirmed when assessing the capabilities of local recycling operations.

What is the particular experience of the private operation - collection, processing, marketing?

How long has the facility been operating?

What volume and types of materials are handled?

Is the facility operating at maximum capacity? Is the facility capable of serving a larger area? Expand its capabilities to handle more and/or different materials?

What is the financial status of the existing operation?

Are there any firm or long term contracts for markets secured?

How much control, with respect to processing or, where the recyclables go, is the private operator willing to relinquish?

Does the facility operator have a proven track record and can the entrepreneurial skills be tapped?

Can the differing motives between a public operation (diversion, environmental, job creation) and private facility (profit) be reconciled? Is the existing operator fulfilling the objectives of the SWM Regions(s) and/or NBDOE?

Is there an interest on the part of a private operator to become involved in a public supported facility?

Depending upon the response to these questions, waste management planners will have to decide on the degree of integration that is most appropriate. For example, in the case of a private facility with sound financial footing and expansion potential, full integration should be considered. However, where volumes and types of recyclables processed are limited and financial records are not divulged by the private operation, considering full integration may not be suitable.

Based on the information obtained in the survey of existing recycling operations, it was determined that the small, less viable recyclers (Gallants and Miramichi Recycling) would be significantly impacted by the establishment of CPF's. It is apparent that at present only SWC Recycling in Fredericton, which currently provides comprehensive ICI and residential recycling services, could be considered to be fully integrated into a new CPF. Given the diversity of the other large non-profit recycling operations, decisions as to if and how they could be incorporated into new facilities would have to be made on a case by case basis. It is suggested, however, that the following be considered prior to any decisions:

1) The larger, more viable commercial recycling operations (Juniper, Saint John and Donald Brun Recycling), which rely primarily on materials from the ICI sector, own their own equipment and employ full time staff. Therefore, it is likely that they could continue their operations independently of and in competition with the CPF. Given the larger service areas of the CPF's, however, it is unlikely the

existing recyclers would have the capacity to provide the total processing requirements of the region.

If an independent recycler does not wish to compete, they could provide specialized services, such as collection, or processing of materials from apartments or smaller ICI generators. Alternatively, they could provide the CPF operation with equipment or a ready labour force that is experienced. It is expected that special considerations such as job protection or a market for used equipment may decrease the financial impact of the establishment of public CPF's.

2) Sussex Recycling and Carleton County Recyclers provide services to their respective communities that go beyond recycling such as promotion of environmental awareness and employment opportunities for developmentally disabled adults. They are also less secure financially in that operating shortfalls are covered by monies from the Environmental Partners Fund. Further they typically rent a large portion of their equipment and storage space. Given that their funding is fixed over a three year period, and because it is difficult to make plans beyond that time, it appears that these operations may lend themselves to a variety of implementation options. Based on their size, however, serving as a regional CPF is not a likely option. They, like their more commercial counterparts, may provide specialized processing services to the CPF's or they may shift workers from the existing projects to the CPF's.

As stated, it will be up to the waste management planners to decide how best to incorporate these operations after considering both financial and social impacts of their choices. At some point however, a fundamental decision as to what recycling objectives are, must be made. Planners must decide if maximized diversion of waste from landfills or a broader objective, which trades off achieved diversion rates against other issues, is sought.

It is suggested that, regardless of final decisions with respect to implementation options, waste management planners acknowledge the concerns of the local recyclers and, where possible, involve them in planning. Many local recyclers have solid information regarding markets or new processing technologies by virtue of being in the business, and goodwill up front may serve all those involved in good stead for the long run.

2.3.2 Experience Elsewhere

In other jurisdictions, a number of approaches have been taken to integrate existing local recycling operations into regional systems. It is suggested, however, that no one approach is necessarily better than another because local circumstances and sensitivities typically dictate the chosen approach.

One common approach is to have the municipality or public entity provide the collection service and have an existing private operator process the materials. In these instances, the private entity may be selected by the municipality to provide the service or they may have to compete with other recyclers. This approach has been taken in Kings County, Nova Scotia and Pittsburg, Pennsylvania. Decisions on how revenues from the sale of recyclables are shared, if at all, vary.

A variation of this method is to have the municipality contract out the entire responsibility for residential recycling services. In order to allow more than one recycler to survive in such an environment and to ensure competition in the long term, some municipalities will let more than one service contract. This approach was taken in Seattle, Washington. Recycling planners recognized that letting only two contracts for residential recycling would be poorly received by the unsuccessful bidders. However, they also realized that if they were to achieve their waste management objectives, that include very substantial diversion goals and to make recycling cost competitive with other waste management options, this approach would be required. They made the somewhat unpopular decision to go with two recyclers but they have achieved their goals of maximized diversion and cost-effectiveness. The unsuccessful bidders on the residential contracts in Seattle were not left out completely as they are still able to handle materials from the ICI generators. Further, this market is enhanced as the City requires ICI generators to achieve certain diversion objectives.

In some jurisdictions, the approach to recycling is to allow activities to be completely market driven. In Portland, Oregon, municipal officials have opted to allow all existing recyclers to compete against one another for recyclables from residential and ICI generators. What this means is that any one street may be serviced by four or five collection vehicles at different times, collecting different commodities at different price rates. This results in very inefficient collection, poor coordination, confusing promotional activities, and higher costs. It also makes it very difficult for the municipality to determine if diversion objectives are being realized or to effect any control over the rates. Given present market conditions and operations costs, this approach is very unlikely.

Finally, many jurisdictions have not made allowances for existing operations. They simply take on the collection and processing of recycling themselves and to a degree compete with the private entities. This allowed the jurisdictions the high level regional public control required to fulfill their environmental objectives, but has caused source disruption upon implementation, where existing services were well regarded in the community. Other jurisdictions have found little resistance from recyclers to their program implementation, where existing services were limited or inconsistent.

2.3.3 Other Considerations

In addition to considering the impact of CPF's on existing recycling operations and ways in which they can be incorporated into regional recycling activities, the impact of sharing specialized equipment between regions and the impact of the proposed beverage container legislation must be considered.

2.3.3.1 Sharing of Specialized Equipment

Because of the relatively small volumes of some wastes generated throughout the province, recycling of some particular recyclable items that require specialized processing equipment is sometimes economically difficult to achieve. Sharing of equipment between CPF's in order to make recycling operations more feasible appears to be a logical approach.

Sharing of specialized processing equipment could avail a wider range of recyclable materials and improve equipment utilization. Lower costs could be attained by users if the capital costs associated with the special processors are allocated over a larger user base. It is suggested that equipment to be shared could include a tire shredder, construction and demolition debris shredders, oil re-refining equipment, and other costly equipment items which require a minimum throughput tonnage larger than the amount generated by any one region. Based on the distances between CPF regions and volumes of specialized recycling streams, it is anticipated that the specialized processing equipment would be transported as required from region-to-region, rather than hauling the commodity from the regions to a fixed location. This equipment sharing function, if viable, could become a function of the Centralized Marketing Agency, addressed in Chapter 6.0 of this report.

2.3.3.2 Proposed Beverage Container Legislation

The impact of the proposed beverage container legislation on CPF's should be considered. Based on a review of jurisdictions where comprehensive deposit/refund systems are in place, the percentage of beverage containers that remain in the recycling system is very small after legislation is implemented. Assuming that the impact beverage container legislation on recycling programs in New Brunswick is similar to the impacts realized in Maine, Alberta and Oregon where such legislation exists, it is predicted that most beverage containers will be diverted away from recycling programs in favour of cash refunds.

What this means is that, when fully implemented, an estimated total of 22,000 tonnes of beverage containers (P. Toner, pers. comm.) including glass, aluminum, tin/bimetal and PET and their associated revenues, will be diverted away from recycling programs. The impact of the proposed beverage container legislation on the processing cost economies and revenues of the CPF's has been tested in the sensitivity evaluation provided in Chapter 5.0 of this report.

2.4 Recycling System Approaches and Performance

Recycling programs of various scopes and sizes are being implemented across the country at an ever increasing rate. To assist waste management planners in deciding whether or not to proceed with or continue particular recycling programs, methods to evaluate and quantify program success are necessary. The degree of success can be evaluated by measuring: participation, recovery, capture, set-out and diversion rates. Evaluation of recycling programs and program planning is also improved by identifying those factors that have an impact on recycling rates and addressing them within the planning process. The impact of various collection methods on recycling rates is also of particular interest. The factors that influence collection rates and their impact on recycling will be identified and discussed in this section, but first a brief discussion of the various methods of evaluating recycling programs is presented.

Participation - typically measures the number of homes that actually set out their recycling container or drop-off materials at a depot, in a one-month period, in relation to the total number of homes served by the recycling program.

Based on a 1990 survey of 1600 pilot and full scale multi-material recycling programs (Glenn, July 1990), participation rates were determined to range between 49% and 92% and average 75% where weekly collection services were provided and average 60% where collection services were provided on a bi-weekly basis. Interestingly, the survey also revealed that average participation rates for voluntary versus mandatory programs differed by only 12%. The participation rate for voluntary programs averaged 72% and increased to an average of 84% in mandatory programs.

While participation rates may provide recycling co-ordinators with an indication of the program's prominence and acceptability, it alone does not give an indication of quantities or materials being diverted from the regular waste stream.

Capture - typically measures the weight of a recyclable material set out in a box or dropped off at a depot by a waste generator over a given time period, in relation to the total weight of the recyclables available or generated over the same period.

Determining capture rates accurately requires that waste management planners have detailed information about the composition of the waste stream, in order to calculate the total weight of recyclables available.

Recovery - is a measure of the amount of material that is being recycled in a community in relation to the total amount of material that could be recycled. Recovery rates are calculated by multiplying participation rates by capture rates.

Set-out - measures the weight of materials placed in a recycling box or dropped off at a depot in a one-month period. Based on information from the Biocycle survey, set-out rates were determined to range between 9 and 30 kilograms per house per month and average 20 kilograms per house per month where weekly collection was provided. As with participation rates, it was noted that set-out rates decreased as collection frequency decreased. The average set-out rate was determined to be 17 kilograms per house per month when collection was provided on a bi-weekly basis.

Diversion - measures the total amount of materials being recycled by weight, over a given time period, in relation to the total amount of waste generated over the same period.

Participation, capture, recovery and diversion rates measure actual figures in relation to theoretical maximums. Program progress is tracked by observing rate changes and as the rates approach 100%, the more successful the program. The set-out rate on the other hand is an absolute measure.

For the purposes of this study, diversion rates have been used as the basis of comparison between the various recycling systems being considered. Diversion rates have been used as the measure because they are readily quantifiable, do not require assumptions about the composition of the waste stream and they allow an easy comparison with the goals established by NBDOE with respect to waste reduction and recycling.

The following section identifies the various factors that influence recycling diversion rates, and presents information pertaining to the diversion rates achieved by various recycling collection systems.

2.4.1 Factors Which Influence Residential Recycling Rates

As recycling programs become more established and operate for sustained periods, waste management planners can more readily identify those factors which influence the quantities of waste being diverted away from conventional disposal methods and into blue boxes or other residential recycling containers. A review of the literature with respect to various recycling programs and discussions with recycling coordinators in Canada and the United States identified the following factors that impact recycling diversion rates:

- Markets
- Promotion of the recycling program

- Peer Pressure
- Convenience of participation
- Frequency of collection
- Number of materials collected
- Legislation requiring recycling
- Recycling costs versus disposal costs
- Recycling system employed

Markets

One of the most significant, perhaps the most significant, impact on recycling diversion rates is whether or not a market for the various commodities to be recycled exists. If there is no demand or need for the materials collected in a recycling program, then recycling simply becomes an inefficient and expensive method of collecting materials for disposal in a landfill. Typically, when recycling programs are initiated, waste management planners must decide which materials will be recycled and this decision is usually made on the basis of markets. If recycling is conducted in an area where markets are abundant and stable the ability to divert waste increases. If markets are not in place, then the ability to divert waste, despite promotion, peer pressure, collection methods or good intentions is severely limited.

Promotion of the Recycling Program

Promotion and public education have a direct impact on the success, popularity and in turn diversion rates achieved in recycling programs. This is because recycling requires that those participating make lifestyle changes. Purchasing habits must be altered such that re-usable and durable products are selected in favour of disposables, and disposal practices must be altered such that the recyclable materials are separated from waste in favour of the "out of sight - out of mind" attitude.

Research indicates that the public cannot and will not participate in any new program unless they know about it, are reminded of it, and are persuaded of its benefits. Given this, sound promotion and ongoing public education is critically important in conveying these messages. Promotional tools include school programs, block leader programs, information brochures enclosed in other utility bills, mass media, local cable programs, newsletters and direct contact with householders. In fact, direct contact with participants was cited as one of the most important and beneficial promotional activities employed.

The direct and indirect benefits of public education and promotional activities include: increased participation in recycling programs, better quality or less contamination of recyclables, increase of awareness of solid waste and environmental issues, and an increased sense of belonging and community spirit.

Typically the costs associated with promotion and education are hidden, but it was determined that half the recycling programs contacted in the Biocycle survey spent from 10 to 50 cents per household on an annual basis and the other half spent $1 to $4 per household annually for promotion.

Peer Pressure

Peer pressure influences the success of recycling. This is particularly so, as recycling becomes more widespread. In fact, recycling is no longer viewed as a fringe type activity, but rather a middle class value. A communications company in St. Louis has gone so far as to suggest that people are responding to the appeals often promoted in recycling programs, not because they are concerned about the environment, but because it's "the thing to do". They have to "keep up". They also suggested that tapping this particular mind-set means promoting recycling the same way other middle class values, such as products of convenience and mass consumption (the antithesis of recycling) have been promoted. It stands to reason that in convincing people to abandon convenient lifestyles recycling messages must be compelling. This is because they have to compete with the other messages telling us to increase our leisure time and to buy pre-processed, disposable and convenience products.

In addition to the "keeping up with the Joneses" attitudes, recycling coordinators often cite the positive effects of neighbourhood streets lined with recycling containers has on participation rates. They provide a constant reminder to recycle, and further, they may plant the seed, "everybody's doing this, so should I".

Convenience of Participation

Convenience of participating in recycling is one of the most significant influences on program success. Participants must be offered a convenient service or at least perceive that recycling will not simply be another chore in the run of an already busy day. Convenience factors include:

- whether or not roadside pick up is provided
- operating hours and locations of depots if roadside collection is not provided
- whether or not roadside recycling collection is the same day as regular garbage day
- how much space is required in the household to store recyclables
- how much preparation and separation of recyclable materials is required
- whether or not a recycling box, stackable bins or bags are provided
- whether or not the recycling container set out for collection must be retrieved
- consistency in program requirements (i.e. the same materials are collected on a sustained basis)
- reliability or quality of service provided

If recycling is not convenient, many people will not participate. This is evidenced by the relatively low diversion rates achieved with depot recycling systems that require the most effort on the part of program participants. "Convenient" recycling programs are those that provide containers for recycling storage, and provide roadside collection service on the same day as regular garbage pick-up. In fact, results from a pilot project conducted in Minnesota revealed that participation rates increased by 43% when recycling containers were provided to householders. It is suggested that the increase can be attributed in part to the added convenience of a container, and to the sense of community spirit which the box may symbolize. Convenience usually also includes weekly pick-up which reduces in-house storage requirements.

Recent studies on "blue bag" pilot programs have indicated that the convenience factor is enhanced when participants are not required to retrieve an empty recycling container after materials have been collected. It is also suggested that co-mingling of recyclables either in a box or bag, as opposed to separating the materials into separate bins, is more convenient. However, in two programs where stacking bins are used, it appears that participants have been convinced through promotional and educational efforts, that the "inconvenience" of extra separation is worth it and participation and diversion rates have not been negatively affected.

Frequency of Collection

Frequency of collection of recyclable materials influences diversion rates. As collection services are provided more frequently, participation rates quantity of materials set-out increase. Conversely, as collection frequency decreases so does participation and set-out. The Biocycle survey determined that participation rates in programs providing bi-weekly collection services were 12% lower than those providing weekly collection. It was also determined that the average quantity of material set out in weekly programs was more than 3 kilograms greater than quantities set out in bi-weekly programs.

It is suggested that participation and diversion rates increase as collection frequency increases for three reasons. First, weekly collection may serve as a more frequent reminder if participants see blue boxes or recycling containers set out in their community. Recycling may become more habitual, like regular garbage disposal, if the service is provided weekly. Thirdly, more frequent collection may allow participants to place more materials in their limited sized containers, if it is emptied weekly.

Number of Materials Collected

As the number of materials collected in a recycling program increases, so does the potential to divert greater quantities from landfills. At the same time, however, program participants are requested to make more of a personal contribution with respect to time (i.e. decreased convenience) when the number of commodities increases. It is suggested that beyond four or five materials and two or three separation requirements on the part of the householder, both participation and diversion may decrease. Residents may wish to recycle but are not willing or interested in remembering a long list of recyclables, how they are to be prepared (washed, rings off, caps off, labels off, etc.) or finding a place to store them until collection day.

Legislation Requiring Recycling

While legislation requiring recycling will impact diversion rates, it is evident that, based on the success of many voluntary recycling programs, legislation is not necessary to entice people to recycle. However, it was determined that where mandatory programs were in place, participation rates were, on average, 12% higher than rates achieved in voluntary programs.

Legislation or bans of the disposal of certain commodities at disposal sites also increases waste diversion rates. Toronto area landfills do not permit haulers to dump loads with a certain percentage of cardboard. A number of American jurisdictions have banned yard waste from landfills in favour of either centralized composting or backyard programs. In addition, legislation requiring a minimum content of recycled feedstock in the manufacture of new products also increases diversion rates. This is achieved because financial or other penalties may be levied against non-compliant manufacturers. It also serves to create a demand for recyclables and in turn improves and stabilizes market conditions.

Beverage container legislation also impacts recycling rates and programs. Deposit/refund systems will see a significant portion of beverage containers diverted from the waste stream, but also from recycling programs. While the ultimate objective is to divert waste from the landfill, program economics and, in turn the sustainability of recycling programs may be impacted by this legislation.

Recycling Costs versus Disposal Costs

Historically, paying for proper waste disposal has been a low priority issue and the relatively small cost associated with improper disposal has been buried in local tax rates. As a result, municipal administrators and waste generators have not been aware of the true cost of disposal. Even where the charges reflect state-of-the-art disposal methods, they are not distinguishable from other municipal services. Therefore, when the unknown or perceived low cost of disposal is compared to the cost of recycling, potential participants balk.

It is suggested that when residents are made aware of the true cost of disposal, realize they are the ones footing the bill, recycling rates increase. In Seattle, the benefits of increased recycling rates accrue directly to residents as they are billed according to the volume of refuse they set out for disposal. For example, prior to recycling initiatives, a family of four may have required a 60 gallon cart for weekly disposal needs which would have cost them $273 per year. After recycling programs were initiated, the same family may decrease their cart size requirements by waste reduction and recycling to a 30-gallon container which would cost $165 per year. When there is a direct benefit to homeowners, decreased disposal costs as in this case, recycling rates increase.

Recycling System Employed

Recycling system diversion rates are dependent on a large number of factors, as identified in the preceding sections. Program success is also a function of the particular collection method utilized. Given that collection methods are a crucial element in recycling and influence overall program success, the following sections will present diversion rates associated with the four collection systems contemplated for New Brunswick.

2.4.2 Collection Methods

Based on a survey of the many recycling collection systems available, four were identified as representative of the spectrum of options available for urban and rural applications. The systems reviewed included:

Drop-off Depots
Co-mingled Blue Box
Source separated Stackable Bins
Co-mingled Blue Bags

Information on the diversion rates that could be expected with various systems was determined by literature reviews and contacts with recycling co-ordinators. After completing the survey of various collection systems and associated diversion rates, it was evident that systems are unique to the community they serve and particular waste management situation the community find themselves in. Therefore, because diversion is influenced by such a wide variety of factors, these rates are not definitive but are indicative of potential diversion rates.

Depots

Depot recycling systems rely on waste generators to separate the recyclable materials from the waste stream and to take them to a given location within certain operating hours. Once at the depots, participants are required to sort their materials and place them in the appropriate container or compartment of a container. When depots are staffed, contamination of materials; (i.e. garbage is mixed in or the wrong commodity is deposited in the container or compartment), decreases and the quality of the recyclables increases.

In depot systems, participants are normally required to provide their own storage containers at home and must be motivated to haul and sort their own materials. Therefore, where curbside waste collection is provided and a special trip to a recycling depot is required, diversion rates are typically in the order of two to three percent of the residential waste stream.

Higher diversion rates have been achieved at depots sited at local transfer stations or disposal sites, where no curbside waste collection is provided and residents must haul their own waste. Officials at the Ontario Ministry of Environment indicated that in these situations, diversion rates may be in the order of seven to ten percent of the residential waste stream. They also feel that this is directly attributable to the fact that residents must make the trip to the transfer station/disposal site anyway. Officials indicated that only marginal increases, in terms of tonnes recovered were achieved when blue boxes were provided as part of a depot system.

Historically, low participation rates, and in turn low diversion rates, have been associated with depot systems. Aside from having to rely on participants to haul the recyclables themselves, rates are low because: depots are usually set up for the convenience of the organizer, not the participant, they are not promoted as vigorously as curbside programs, and they usually do not provide in-home storage containers. Depots must be located in close proximity to their potential users and provide good access in order to attract even these low diversion rates.

Co-mingled Blue Box

Co-mingled blue box programs are the most common and well known type of recycling program. Residents are required to separate recyclable materials from their waste, place it in a storage bin (blue box, orange pail, etc.) usually provided by the program organizer, then place them at the roadside curb for collection. When the materials are picked up, they are separated and placed into compartments in the recycling collection vehicle.

The step of roadside separation requires considerably more time to complete collection routes, but contamination rates are relatively low. In some co-mingled curbside programs, materials are not separated at the curbside, but are dumped into a single compartment and the materials are separated at a processing facility. This improves collection efficiencies but the degree of contamination and processing costs increase.

Blue box programs are typically well received and participation rates achieved are in the order of 60% to 70% and diversion rates are normally in the order of 15% of the residential waste stream.

Source Separated Stackable Bins

Source separated stackable bin systems require program participants to separate recyclable commodities from their waste, then into separate storage bins for curbside pick-up. Because of the relatively high cost of purchasing and replacing containers, the need for a dedicated recycling vehicle and a considerable effort to "teach" program participants how to recycle, the system is not commonly used. Despite these drawbacks, it appears this system can achieve higher participation and diversion rates than blue box programs. If higher diversion rates are achieved, it is likely due to the inherent need to promote, explain and remind residents to recycle, and because contamination rates are lower than those in other systems. In the north-end of Seattle, where this system is utilized, participation rates are 90% and the monthly set-out rate is 32 kilograms per house.

Other reports of stackable bin systems indicate that diversion is not improved relative to blue box programs. The nuisance factor of required resident separation of materials, and storage and handling of the three or more bins counteracts other positive elements of the system.

Co-mingled Blue Bag

In this type of system, co-mingled recyclables are placed in a blue, or a coloured bag that is easily distinguished from a regular garbage bag. It is then deposited at curbside for pick up. The bag may be collected with the regular household refuse in a compaction vehicle or separately in an open vehicle or packer truck. This system is favoured by many recycling co-ordinators because the purchase, distribution and replacement of containers is not necessary, nor is the purchase of dedicated recycling vehicles. Further, using a bag as a container is convenient because it is lightweight, easy to carry, allows higher set-out rates and it does not have to be retrieved after the collection vehicle has gone by. Despite the convenience of a bag program, waste management planners are well advised to consider two important factors prior to proceeding with blue bags: processing requirements and contamination. In order to process recyclable materials, blue bags must first be opened which adds a minor, but important extra step. Opening a large number of bags efficiently poses a particular challenge to processors. In fact, this has been a problem in the Winnipeg, MN program.

Contamination (broken glass primarily) of recyclables within the bag should also be considered. Given the nature of the recycling container, contamination levels are typically higher than in those found in more conventional blue box systems. The contamination problem is compounded further by the collection method employed. If separate collection is provided in packer trucks, as opposed to non-compaction vehicles, contamination rates will increase. If co-collection is utilized, where garbage bags and recycling bags are in the same compaction vehicle, contamination will be even greater.

Two methods of reducing contamination are commonly used. They include: modifying compaction ratios of the compaction vehicle and by using thicker bags. In a city of Chicago pilot study to examine blue bag viability, recycling blue bags that were 1.75 millimetres (mm) thick (regular bags are typically 1.0 mm in thickness) were collected with garbage in a collection vehicle with modified compaction ratio. Compression in the modified vehicle was approximately 600 pounds per square inch (psi), whereas compression rates for garbage collection are usually between 1500 and 2500 psi. When the trucks were emptied for sorting, between 85 and 90% of the blue bags were intact.

At present, blue bag systems are being utilized on either pilot scale levels or are being implemented on a phased-in basis. Municipalities trying out blue bags include: Halifax, NS; Pittsburg, PA; Houston, TX; Winnipeg, MN; Danbury, CT; and Chicago, IL. The City of Halifax blue bag program will serve 30,000 residential units in the municipality. Implementation of a blue bag program represents an expansion of current recycling efforts which involves weekly curbside pick-up of old newspaper (ONP). In the new program, aluminum and mixed glass will be collected in the blue bags and the ONP will continue to be picked up in grocery bags, apart from the blue bags. In addition to the glass, aluminum and ONP, the blue bags will also be recycled. Plastic bag producers, with an obvious interest in blue bag systems, will often offer to accept the bags to be recycled. This helps stave off complaints that the blue bag system adds another disposable item to the waste stream, the blue bag itself.

The four commodities will be collected, processed and marketed by Enviro-Care Services. This company, contracted by the City of Halifax, will provide curbside collection utilizing trucks that have been divided into two compartments, one which will hold blue bags and one for ONP. The recyclables will then be transported to their processing facility where the bags will be opened manually and the commodities sorted. Once sorted, the materials will be processed as required and shipped to brokers or end-users.

City officials are anticipating that when fully operational, approximately 2,000 tonnes of ONP, 750 tonnes of mixed glass, 25 tonnes of aluminum and 10 tonnes of plastic blue bags will be diverted from the residential waste stream annually. Based on annual, residential waste generation rates in Halifax, that level of recycling activity is equivalent to a diversion rate of nine percent.

The City of Halifax also indicated that a blue bag program was selected over a depot and blue box system. The depot concept was dropped because of the high cost of establishing and staffing depots, as well as concerns about litter, noise, vandalism and dumping of wastes and recyclables after operating hours. The blue box system was eliminated because of the cost of providing containers and dedicated recycling vehicles.

Pittsburg, PA has launched a city-wide blue bag program that has been met with favourable response in the one area of the city where it has been implemented. As part of the program launch, blue bags were distributed, at no charge, to residents as an incentive to begin recycling. As the program continues, participants will have the opportunity to either purchase blue bags from a number of bag manufacturers or simply re-use the blue grocery bags provided by a number of grocery stores in the city. In an attempt to remove a cost barrier (i.e. not requiring the special purchase of blue bags), a number of grocery store chains opted to switch from paper or white plastic bags to the blue plastic bags that could be used in the recycling program.

Existing collection vehicles, with compaction ratios modified, will be used to collect the recyclables which will serve to make collection more efficient. Collection of materials at full compaction levels would make collection routes more efficient, but the contamination from the crushed glass amongst the other commodities would offset this. Interestingly, the recycling co-ordinator noted that in order to avoid the perception that recyclables separated by householders were not simply ending up with the rest of the garbage, the fleet of recycling trucks would be painted to distinguish it from the other waste collection vehicles.

While a number of municipalities have tried blue-bag recycling, or are currently involved in pilot programs, there appears to be a lack of data surrounding the viability of this recycling method. Bag manufacturers quote high participation rates but diversion rates tend to be similar to rates achieved in other permanent container systems because of higher contamination levels in bag systems.

For the purposes of this study, a diversion rate based on rates achieved in pilot projects in Danbury, CT and Winnipeg, MN is suggested. In these programs, approximately 15% of the residential waste stream was diverted.

A more detailed description of these residential recycling collection systems and the range of vehicle options is provided in Chapter 4.0.

2.4.3 Residential Commodities Collected

In residential recycling programs, participants are typically asked to separate approximately six commodities out of their waste stream. Materials collected include: newspaper, glass, rigid plastic, plastic film, aluminum and tin. A limited number of programs are now including cardboard, as well as fine paper. Historically these have not been collected in residential programs because they are usually generated in more significant quantities in the ICI sector.

In the survey of residential recycling programs in Canada and the U.S., it appears that the composition of materials collected for recycling did not vary significantly as collection methods varied or from community to community, except, the percentage of newspaper was noted to decrease as the number of materials collected increased. The commodity breakdown is presented in Table 2.5.

2.4.4 ICI Recycling Systems

For the most part industrial, commercial and institutional (ICI) waste recycling activities have focused on materials which have either high recycled value, and/or are by-product waste which otherwise entail complicated or high cost disposal.

In most cases ICI recycling has been handled exclusively by the private sector, with very minimal public involvement. Examples include the handling of scrap metals by scrap dealers, oil and other petroleum products by re-refining companies, fish offal to fish meal for feed and fertilizer producers, wood chips for incineration plant fuel, and tires for various rubber products, and office papers and cardboard for pulp mills.

While the responsibility for ICI recycling has principally been left in the hands of the private sector, public environmental regulations have encouraged ICI recycling. For instance, many waste disposal sites refuse to accept various types of industrial wastes with physical properties or volumes counter to the disposal site operations. As residential recycling programs have become more widespread, public officials are beginning to turn their attention towards expanding the extent of ICI recycling.

TABLE 2.5

COMPOSITION OF RECYCLABLES

	Newspaper	Glass	Mixed Plastic	PET	Plastic Film	Alum	Tin
DEPOTS							
Howard Co., MD	63%	30%			4%	1%	2%
Portland, ME	64%	19%	7%			[1]	5%
Everett, WA	68%	30%					1.4%
BLUE BOX							
Fredericton, NB	64%	27%	4%		1%	1%	
Kings Co., NS	56%[2]	30%			1%	1%	12%
Seattle(S), WA[3]	75%[4]	20%		.5%		1.1%	2.6%
STACKING BINS							
Seattle(N), WA[3]	72%[4]	20%		.3%		1.4%	3%
Fitchburg, WI	68%[4]	22%	3.9%	.8%		1.6%	4%
BLUE BAG							
Winnipeg, MN[5]	67%	23%		2%	1%		7%[7]
Danbury, CT[6]	58%	20%	5%				5%[7]
ALL SYSTEMS							
Range [8]	55%-86%	11-31%		1%		2%	3%

[1] Aluminum is accepted by amount collected is negligible
Program Co-ordinator cites deposit/refund as the reason

[2] Program Co-ordinator suggest ONP is lower due to the lack of a local daily paper

[3] Contamination in the south accounts for 2.5% of the total amount collected

[4] Includes mixed paper

[5] Pilot program

[6] Pilot program included 10% OCC and 11% contamination

[7] Includes aluminum

[8] Biocycle Survey

Recently, many landfills have begun to refuse some ICI wastes previously accepted, such as cardboard. In a few cases financial incentives are being provided, such as no tipping cost for cardboard separated for recycling, or even a nominal fee paid.

The public sector has also become involved in the collection of ICI recyclable materials. The Fredericton Solid Waste Commission provides a free office papers pick-up service to offices and business throughout the city. However, in general the private sector has handled recycling on its own through contracted pick-up service or their own delivery to consuming markets.

As such, ICI recycling has been largely market-driven, and subject to public environmental disposal constraints, market availability and market prices. Diversion levels have not been very high, where strong incentives or environmental directives and enforcement have been absent. Many public officials believe that if high diversion levels of wastes from disposal sites through recycling are to be achieved, a concerted effort must be made to divert ICI recyclables. This may require much higher involvement of the public sector, through strict regulations, incentives and/or provision of collection services.

A more detailed description of ICI collection approaches and vehicles is provided in **Chapter 4.0**.

2.5 Markets for New Brunswick Recyclables

Fundamental to the success of any recycling program, residential and ICI, is the availability of markets for the recycled materials. The market for recyclable material is different from other commodities, because recycling depends largely on the demands of the secondary materials markets rather than supply or availability of the product. Recycled products must compete with "virgin" products, which in many cases are less expensive than the products using recycled materials. An example would be recycled waste paper competing with pulpwood.

A material market survey has been undertaken for this study to help determine who is buying or accepting recycled materials, what the specifications are, the current prices paid, and any information on predicted costs. The shipping cost of recyclables limits the markets available to New Brunswick generated materials. The market survey, therefore, concentrated on markets in New Brunswick, Nova

Scotia, Ontario, Quebec and the New England states. The survey was undertaken during the first quarter of 1991. The markets for recyclables have proven to be very volatile to date, both in terms of availability of regular and stable purchasers/consumers of recycled material, and in price. This market and price volatility can be expected during the coming few years as more recycling programs (ie. supply) and recyclable consuming industries (ie. demand) come on stream in the market place.

Large industrial waste materials that can be recycled or re-used (for example plastics, organic chemicals and solvents, textiles and some metals) would normally not end up at a material recovery facility. They are usually best dealt with by waste exchange programs, and therefore have not been included in this market survey. The market survey instead focused on recyclable materials, which would likely be handled by the regional central processing facilities examined in this study. They include paper products, plastics, glass, aluminum cans, used oil, tinned steel cans, tires and other scrap metals.

2.5.1 Paper Products

The types of paper that are presently being recycled in Canada include newsprint, old corrugated cardboard, a variety of office paper, computer paper and boxboard.

The largest consumers of recycled wastepaper are pulp and paper mills. There are currently 59 pulp and paper mills in Canada that manufacture newspaper and paper board products. Only 19 of these mills accept and use wastepaper as part of the manufacture of new paper. Presently, in New Brunswick, there is only one pulp mill using recycled newsprint as part of the manufacture of new paper.

The largest problem with recycling newsprint is the ink. If a de-inking facility was available in New Brunswick, it would allow a larger number of local mills to use recycled newsprint in their paper-making process. Increasing the number of mills that could use recycled newsprint would free up the existing restrictions on the demand, thereby allowing the price of recycled newsprint to increase.

Information published by the Canadian Pulp and Paper Association indicated that only 3% of Canadian newsprint production in 1989 contained recyclable paper, but by 1993 this figure is predicted to increase to 19% (1,500,000 tonnes). The low

Canadian domestic consumption of newsprint relative to production will require mills to import old newsprint from the United States in order to meet the demands for recycled newsprint.

Other markets for newsprint include absorbent and insulation manufacturers. These markets usually consume a small amount of newsprint and could not be the sole market for recycled newsprint in New Brunswick.

The major source of recyclable office paper and stationery is the collection/sorting operations within office buildings. Cuttings and trim from converting operations of these products are normally recycled as high grade recyclable paper or pulp substitute. These grades may be recycled into a variety of products such as tissue, fine papers, newsprint and paperboard. Canadian consumption of office paper and stationery was 565,000 tonnes in 1989 and only 68,000 tonnes of the office paper produced had recycled content (Canadian Pulp and Paper Association, 1990). Pulp and paper mills are the largest market for recyclable office paper. Officials from Cascades Inc. indicated they could accept all the recycled office paper collected in New Brunswick.

New technologies for recycling wastepaper are evolving continuously. For example, Recoupe Recycling Technologies has developed a new high pressure technique for recycling paper. Based on steam, the new process could eliminate the need for a separate de-inking step. There are plans to construct a pilot plant within the next year.

Newspaper

Fraser Inc., located in Edmundston, New Brunswick, presently recycles newsprint at a rate of 220 tonnes/month and pays $60/tonne for the newsprint at the mill. Fraser Inc. expects to increase the amount of recycled newsprint used in its manufacturing process within the next year. The company is investigating the possibility of collecting and shipping newsprint to a de-inking facility and bringing it back to the mill for processing.

Quebec and Ontario Paper Company Ltd. is the largest pulp and paper mill recycler of newsprint in Canada. They estimate that they will recycle 15,000 tonnes of newsprint per month in 1991. This company has entered into contracts with various Ontario municipalities for the supply of recycled newsprint. Quebec and Ontario Paper Company Ltd. pays between $30-40/tonne for recycled newsprint plus shipping costs.

Abitibi-Price Inc. has a pulp and paper mill located in Chandler, Quebec, that presently recycles 930 tonnes of recycled newsprint per month. The company is investigating the costs of building and operating a de-inking facility. A de-inking facility would increase their demand for recycled newsprint to 3,700 tonnes/month. The company pays $40/tonne for recycled newsprint and will pay shipping costs (Fredericton to Chandler, by truck - $31/tonne; by rail - $16/tonne).

An official from Abitibi-Price Inc. provided estimates of the price that will be paid by Abitibi-Price Inc. pulp mill for recycled newsprint from 1990-2000. The high and low price expected for newsprint and the most likely price is as follows:

Estimated Price Paid for Recycled Newsprint
$/Tonne

	High	Low	Most Likely
1990 - 1995	41	26	34
1995 - 2000	49	34	41

Note: The price on this table does not include shipping costs, which are paid by the mill.

There is a market for newsprint at Ontario pulp and paper mills. However, the price paid for recycled newsprint would have to increase substantially to compensate for the transportation cost.

Table 2.6 summarizes the information on the mills now recycling newspaper, the quantity recycled and the price paid for material at the mill.

Laidlaw Resources has recently entered into an arrangement with Canadian Pacific Forest Products, whereby they will act as exclusive agents for the supply of recycled newsprint. They have agreed to supply up to 25,800 tonnes/month of recycled newsprint to a pulp mill in Gatineau, Quebec and a pulp mill in Thunder Bay, Ontario.

TABLE 2.6

PULP AND PAPER MILLS RECYCLING NEWSPAPER

Pulp and Paper Mill	Quantity	Price
Fraser Inc. (Edmundston)	220 tonne/month	$60/tonne
Quebec and Ontario Paper Company Ltd. (Thorold, ON)	15,000 tonne/month	$30-40/tonne + shipping
Abitibi-Price Inc. (Chandler, PQ)	3,700 tonne/month	$40/tonne + shipping

Laidlaw has signed a 10-year contract with various brokers throughout Canada in order to meet the objective of 25,800 tonnes/month. These contracts are to supply quantities in the range of 80 - 240 tonnes/month, but they prefer to sign contracts for a minimum of 800 - 1600 tonnes/month. They pay approximately $27.50/tonne. This will increase by a factor of 50% of the consumer price index (CPI) in subsequent years.

This market initiative may develop to include other pulp mills. Should this project be a success, there may be the potential for a long-term market at a fixed price with Laidlaw.

Thermocell Insulation Ltd. is located in Debert, Nova Scotia. The plant processes an average of 170 tonnes/month of newsprint. The company produces insulation and hydroseeding used in road construction. Thermocell Insulation Ltd. pays between $30-35/tonne for newsprint. The newsprint must be clean, dry and free of paper high in clay such as would occur in glossy advertisements.

Canbrand International Ltd., located in Moncton, New Brunswick, processes 65 tonnes/month of newsprint for the manufacture of kitty litter. This company pays $40/tonne for clean, baled newsprint, free of colour flyers, and coated paper. They would like to expand their business in the next couple of years.

The agricultural industry has been investigating the potential of using shredded newspaper as cattle bedding. Several farmers in the State of Pennsylvania are presently using such a product in this manner. Their experience indicates that 750 lbs. of newspaper is required for each animal per year (Temple, 1990). There are approximately 26,000 dairy cattle and 40,000 beef cattle in the province of New Brunswick (Pers Comm. with N.B. Department of Agriculture). This yields a potential market for 1,900 tonnes/month of shredded newspaper for New Brunswick farmers. In order for recycled newspaper to be competitive as cattle bedding, it must compete with the price of straw.

A New Brunswick broker is selling newspaper for cattle bedding to local farmers for $40/tonne. The newspaper is clean (flyer free), but is not shredded. There may be a slight increase in the selling price if the newspaper were shredded.

Old Corrugated Cardboard

The pulp and paper mills are the largest consumers of recycled corrugated cardboard (OCC). There are two mills in New Brunswick processing OCC; Stone-Consolidated Inc. and Lake Utopia Paper Limited.

Stone-Consolidated Inc. has the potential to recycle approximately 6100 tonnes/month of corrugated cardboard. A large percentage of this is trimmings from the production of boxes rather than post-consumer material. Presently they are not recycling post-consumer cardboard but expect to be doing so in six months. Stone-Consolidated Inc. will be paying $30-35/tonne for corrugated cardboard.

Lake Utopia Paper Limited recycles 2,000 tonnes/month of corrugated cardboard. A large percentage is box trimmings from the plant, rather than post-consumer material. Lake Utopia Paper Limited was purchasing OCC only from Saint John Recycling located in Saint John, New Brunswick. Lake Utopia pays $55-110/tonne delivered to the mill. The OCC must be baled, clean and free of glue and tape.

Minas Basin Pulp and Power Company Limited, located in Hantsport, Nova Scotia, purchases OCC through Scotia Recycling. Scotia Recycling will pay $44/tonne for OCC delivered to their recycling facility in Dartmouth, Nova Scotia where the cardboard must be dry and contaminant free (plastics, glue, tape). Minas Basin Pulp and Power Company Limited officials were unwilling to provide information regarding the amount they pay Scotia Recycling for the recycled newsprint.

Boxboard

Boxboard is a commodity that may be recycled, but is presently not collected by any New Brunswick brokers or recyclers.

Fraser Inc. in Edmundston, New Brunswick recycles boxboard. However, their supply is generated in the United States. Fraser Inc. would be interested in purchasing boxboard in New Brunswick if it were available. The company would require the boxboard to be baled (454 kg.) and would accept a minimum shipment of 20 tonnes. Fraser Inc. pays between $35-60/tonne for boxboard.

Fine Paper

Cascades Inc., located in Kingsley Falls, Quebec, recycles a variety of wastepaper, including computer paper, white and coloured paper. The amount Cascades Inc. will pay in 1990 for the various grades of paper is presented in **Table 2.7**. The shipping cost is not included in the table, but is paid for by the company. Cascades Inc. requires that all bales be identified by name of supplier, the grade of paper, the date and the total weight. The paper must be baled (464 kg) and contain less than 2-3% contamination (paper grades other than the type specified of the bale). Officials from Cascades Inc. indicated that they could accept all the office paper that New Brunswick sources could supply.

Directories

In Canada, 45,000 tonnes of paper were used to print telephone directories. There are three cities in Canada collecting both white and yellow telephone books as part of their recycling program: Toronto, Guelph and Mississauga. The City of Guelph collected the 1989 residential phone books but have been unable to find a market. The City of Mississauga collected residential phone books and paid Laidlaw to dispose of them. The major difficulties encountered in recycling old directories are the removal of the glue from the spine. Bell Canada Limited is starting to use a water soluble glue in the binding of telephone directories. A Laidlaw representative indicated that when this problem is overcome, the pulp and paper mills in Canada will be able to recycle the directories. Quebec and Ontario Paper Company Ltd. has been investigating the potential of recycling directories with their newsprint.

TABLE 2.7

PRICE PAID FOR VARIOUS GRADES OF RECYCLED PAPER

Type of Paper	Price $/tonne
Mixed paper - low quality	5
Mixed paper - high quality	40
Newsprint	25
De-inked newsprint	175
White kraft - strongly imprinted	125
White kraft - lightly imprinted	200
Coloured paper	140
White ledger	200
Computer paper (C.P.O.)	250
Multi wall	200
Ground wood	110

Laidlaw presently pays $28/tonne to ship the directories overseas to India and China for recycling.

Uthane Research Limited, an absorbent manufacturer in Unionville, Ontario is recycling telephone directories. They do not pay for the directories, but will accept all those delivered to their facility.

Magazines and Catalogues

The current markets for recycled coated papers are very low in North America. The only market that exists in Canada for the use of recycled coated papers is in the manufacture of some newsprint. Technical limitations lie in the one type of de-inking process generally used in North America; ie. wash de-inking. However with flotation de-inking the recycling of coated paper is facilitated. Floatation de-inking of newsprint requires 30-40% coated paper in the feed stock for optimum performance.

Floatation de-inking involves combining the pulping and cleaning action of waste washing with air bubbles that help carry off ink particles. Unlike washing techniques, which removes only those ink particles larger than 30 micrometers in diameter, floatation removes around 85% of the smaller particles present. It also cuts water use in half, resulting in a much smaller volume of sludge requiring disposal.

Abitibi-Price Inc., in Chandler, Quebec, is presently using 400 tonnes/month of coated paper in the manufacturer of newsprint.

2.5.2 Plastics

The recycling of plastic is more complicated than the recycling of other commodities because it involves a complex variety of materials. There are numerous types of resins which in most cases must be kept separate from each other to be marketable. The focus in plastic recycling is on common thermoplastics resins. Five of the most common thermoplastics resins are Low Density Polyethylene (LDPE), Poly-vinyl Chloride (PVC), High Density Polyethylene (HDPE), Polystyrene (PS) and Polyethylene Terephtalate (PET).

The processing of these individual resins is relatively straightforward. Generally, the material is brought into a facility, it goes through some type of cleaning process, is shredded or ground and then melted and reformed in an extruder. From that point the recycled resin is put back into the manufacturing process.

Of all the resins available, the two most frequently recycled are HDPE and PET. One of the reasons for this is the applications of these resins. More than half of all HDPE is used in packaging (largely milk bottles) and approximately one third of all PET is used for soft drink bottles. These two products are easily identified and easily targeted for collection.

Most of the recycled PET is used in the fibre market for such products as carpets and fibrefills. Other applications include industrial strapping and the automotive industry (distributor caps). Although presently reclaimed PET cannot be used in food-contact applications, it is increasingly being used to produce other bottles. Eastman Kodak is working on a process which reverses the polymerization chemical reaction and returns the PET to its raw materials. These raw materials can then be reacted to produce new PET which may be used in food-contact bottles.

The amount of HDPE available from all sources for recycling is approximately four times greater than that of PET. In packaging, HDPE resin is used and available for recycling more than twice as often as PET. Most recycled HDPE is used in construction products such as pipes, and to make lumber-like products. Various companies are manufacturing bottles containing recycled HDPE. The bottles are made with three layers, a layer of recycled HDPE between two virgin layers.

Low Density Polyethylene (LDPE) is the most commonly used plastic resin of all thermoplastic resins. The only source of post-consumer LDPE currently being recycled is grocery bags. The bags may be collected and recycled back into other grocery bags.

Currently, of all the resins recycled, Poly-vinyl Chloride (PVC) has the least amount of post-consumer material recycled. While PVC ranks second to LDPE in resin sales, only about 10 percent of the total manufactured is used in packaging. It is most commonly used in building materials such as pipes, house siding, window and door frames and floor covering. These products have a longer useful life-span than packaging products and therefore are not as readily available for recycling.

Although polystyrene products make up less than one percent of the solid waste stream, they are perceived by the public as a major problem in solid waste disposal. North American industry produces over two billion pounds per year of disposable polystyrene products such as cutlery, dishes, assorted packaging, cups and fast food containers.

The reclamation of polystyrene is similar to that of plastic bottles; sorting, granulating, washing, drying and repelletizing for re-use. These pellets become the raw material for new polystyrene products such as office products, video cassettes, toys and trash cans. Until recently, post-consumer polystyrene could not be used in the manufacture of food related product. It is now acceptable to use recycled polystyrene between two virgin layers of polystyrene in the production of food containers.

Presently in New Brunswick there are no plastic processors or end-users for plastic except LDPE. The Fredericton Solid Waste Commission operates the largest organized program in the province that collects plastics. They presently collect PET, HDPE and LDPE. However, no PET or HDPE had been shipped from Fredericton since March, 1990. The plastic processors and end-users available to New Brunswick are located in Ontario, Quebec, Nova Scotia, Maine, Vermont and New Hampshire.

High Density Polyethylene (HDPE)

Proctor and Gamble (P & G) and Dupont Canada have jointly developed a post-consumer recycling plastic program. Under this program, High Density Polyethylene plastic containers gathered in curbside collection programs will be sorted, ground into flakes and cleaned by the Plastic Recycling Alliance (a joint venture of DuPont and Waste Management, a Toronto company). The flakes will then be processed into pellets by DuPont and sold to PLAX, a P & G bottle supplier, for use in making bottles. The program calls for an initial 25% post-consumer recycled plastic in P & G bottles, with an eventual goal of 50%.

Dupont pays $140/tonne for HDPE plastics. The plastics must be baled and may not contain more than 3% contamination by weight (other plastics, oil bottles, household hazardous waste bottles).

Polyethylene Terephtalate (PET)

Twinpac Inc. and Péloquin Recyclage recycle the majority of PET plastics in Quebec and Ontario.

Twinpac Inc. collects PET plastic from various municipalities throughout Ontario. The amount Twinpac Inc. will pay for PET plastic depends on the total volume. They pay $300/tonne for shipments greater than 13.5 tonnes and $200/tonne for shipments of less than 13.5 tonnes. The plastic must be baled and free of caps. They will not accept soft drink bottles that have HDPE bottoms. Twinpac Inc. resells the baled plastic to Péloquin Recyclage in Quebec.

Péloquin Recyclage collects PET soft drink bottles throughout Quebec and other parts of Canada. The bottles they collect and recycle in Quebec are only from the organized deposit drop-off system set up throughout the province. Péloquin does not accept PET plastics collected in curbside pick-up programs (blue-box system) on a regular basis. However, the company has accepted PET plastic from a few Ontario municipalities using blue-box pick-up program, and will pay $77-88/tonne for this PET plastic. Péloquin is leery about taking PET plastic collected in curbside pick-up programs because of the PVC contamination.

The bottles are baled in Péloquin's Montreal plant and their materials recovery facilities throughout Quebec. The bales are then shipped to the Pélo Plastique facility in Berthierville where the material is colour-sorted, decontaminated, granulated and converted into PET flakes. Péloquin Recyclage will pay $175/tonne for PET plastic delivered to the facility from bottle suppliers.

Eastman Chemical Company (ECC) has reported success in reclaiming used PET bottles. Recently, in Eastman Kodak's methanolysis unit in New York, several thousand pounds of clean post-consumer bottle flakes were successfully processed. This process, known as methanolysis, reverses the chemical reaction and returns the PET to its raw material. These raw materials can then be reacted to produce new PET for use in any number of applications, including new bottles.

Eastman Chemical Company were unable to provide information on the quantity of PET that they would recycle or the amount they would be willing to pay for post-consumer PET. Eastman representatives indicated that the product from this process would open the door for PET recycling. It would increase the demand for post-consumer PET, thus raising its purchase price.

Low Density Polyethylene (LDPE)

The only source of post-consumer Low Density Polyethylene (LDPE) currently being tapped is grocery bags. **PCL and Eastern Packaging Ltd.** in New Brunswick is one of the largest grocery bag recyclers in North America. Currently, about a quarter of their total production is from recycled LDPE. They employ about 30 people to remove paper and other contaminants prior to the LDPE being washed and pelletized.

The company presently pays approximately $440/tonne for loose or baled bags. PCL will purchase as many plastic bags as can be supplied within the Province of New Brunswick.

Polystyrene

Canadian Polystyrene Recycling Association, located in Mississauga, Ontario, expects to be operating a polystyrene recycling facility by May, 1991. The facility will recycle 500 tonnes/month and will accept post-consumer and industrial polystyrene. They are negotiating a purchase price for industrial polystyrene, but will not pay for post-consumer. The company is investigating the potential of building a facility in Quebec.

Plastic Again, located in Leominster, Massachusetts, recycles 45 to 57 tonnes of polystyrene per month. The company pays one hundred dollars (US) per tonne for baled polystyrene delivered to their facility. The bales must contain less than two percent contamination (food, other plastics). Plastic Again produces a pellet which is sold to various polystyrene manufacturers. The company will be opening three more recycling facilities within the next year.

Mixed Plastics

Plastic scrap may be collected as a mixture of many types of plastics. Separation of this mixture into its various plastic components can be costly. It is possible to process the mixed plastics into products such as lumber substitutes for miscellaneous outdoor furniture posts and farm structures.

Superwood Ontario Ltd., a Mississauga, Ontario, company manufactures recycled mixed waste plastics into a wood-like board that can be used in picnic tables, barn floors, docks, fencing and highway signs. The product is waterproof and resistant to rot, rust, sunlight, corrosion and chlorine. The Mississauga plant recycles 290 tonnes of mixed plastic per month and pays $60/tonne for the mixed plastic.

Superwood Ontario Ltd. is investigating the possibility of constructing a facility in New Brunswick. The facility is expected to process 290 tonne/month of mixed plastics.

2.5.3 Glass

The largest market for recycled glass is bottle manufacturers. Colour sorting is essential so glass plants can ensure that newly manufactured containers match the colour standards requested by customers. However, there is some tolerance in colour separation. While specifications may vary, the following gives an idea of permissible colour mixture:

Tint (clear) glass		Amber		Clear	
95-100%	Clear	90-100%	Amber	95-100%	clear
0-1%	Green	0-10%	Green	0-1%	Green
0-5%	Amber	0-10%	Clear	0-5%	Amber
0-5%	Other	0-5%	Other	0-5%	Other

Glass must be virtually contaminant-free for it to be marketable. Contaminants that can be found in recycled glass include metal caps and lids, ceramics, stones and dirt.

Some markets do exist for mixed-colour "cullet" usually in the fibreglass and reflection bead industry. However, these markets are unstable and not as lucrative as those for colour-sorted glass (Gibboney, 1990).

Consumers Glass, located in Scoudouc, New Brunswick, produces glass bottles of various sizes, shapes and colours. It purchases bottles and broken glass to use in its manufacturing process. The product contains up to 75% recycled glass. Consumers Glass receives, on an average, 195 tonnes/month of glass from suppliers in New Brunswick.

In order to reduce administrative costs, Consumers Glass has recently entered into agreement with Ryan Investments, Archie Fader and Shediac Pallet Ltd. (brokers) to be their sole suppliers of furnace ready cullets. The three brokers pay $43.50/tonne for glass delivered to their facilities. Consumers Glass is looking at entering into an agreement to accept glass from the Fredericton Solid Waste Commission within the next year.

Péloquin Recyclage collects glass containers from various suppliers in Quebec and Ontario. The containers are colour-sorted, cleaned and crushed at their Montreal facility. The crushed glass is resold to glass container manufacturers. Company representatives indicated that the price for recycled glass has been stable for the last 10 years and should remain stable. Péloquin Recyclage pays $38-44/tonne for clear glass.

2.5.4 Aluminum Cans

There are several brokers purchasing aluminum cans in the province of New Brunswick. The brokers pay between $660-770/tonne of aluminum cans. They will accept loose or baled cans.

Péloquin Recyclage in Montreal, PQ collects aluminum cans from all regions of Quebec, Eastern Canada and the United States. The aluminum is collected and decontaminated after which it is compacted into bales. The aluminum product is dried, shredded and melted, before being cast into ingots. The ingots are sold to conversion plants to be transformed into a wide range of products such as cans, wrapping foil and sheet products. The majority of aluminum cans recycled by

Péloquin Recyclage are the cans that have been returned to the local grocery stores for a deposit refund. They will pay $600-800/tonne for aluminum cans.

Alcan Recycling Canada, located in Montreal, Quebec, collect post-consumer aluminum cans. They pay $1,060/tonne for baled aluminum cans. Representatives of the company indicated that they would purchase all the aluminum cans collected in New Brunswick.

2.5.5 Used Oil

Entrepreneurs in New Brunswick and Nova Scotia are developing processes to re-refine waste oil. In the province of Nova Scotia, waste oil is regulated under the "Waste Oil Regulations". The regulations stipulate that waste oil cannot be processed if contamination levels exceed a specified limit, as shown below:

MAXIMUM ALLOWABLE CONTAMINATION LEVELS

Contaminant	Maximum Allowable Levels (mg/l)
PCV's	5
Total Halogens	3,000
Arsenic	10
Cadmium	5
Chromium	20
Lead	500

The province of New Brunswick does not have regulations regarding waste oil. However, the New Brunswick Department of the Environment requires that waste oil processors obtain operation approval under the industrial section. The maximum allowable contamination in the waste oil process feed will be stipulated in their approval.

Inland Oil Re-refining Company Ltd. in Truro, Nova Scotia will recycle 2.2 million gallons of used oil a year. The process will be in operation at the end of March, 1991. They are collecting waste oil in Nova Scotia and New Brunswick. Various New Brunswick gas stations collect waste oil from do-it-yourselfer oil changers, and pay Inland Oil to dispose or re-refine the used oil. The used oil that does not meet Inland's process requirements is shipped to Ontario and Quebec for proper disposal.

Sussex Manufacturing, located in Sussex, New Brunswick, is a manufacturing unit that will recycle waste oil. The capacity of the units range from 60-250 gallons/hr. The company hopes to operate three or four units in New Brunswick. Waste oil generators will have to pay 20-30¢/gallon to dispose of the oil.

2.5.6 Steel Cans

All post-consumer steel cans (food and beverage) are recyclable. The first step in recycling cans is the detinning process, in which tin is removed from the tinned steel can. The detinning companies sell the detinned steel to steel mills to use in the steel-making process. In order for food and beverage cans to be marketable, they should be cleaned, flattened and baled. There are three companies in Hamilton, Ontario collecting cans; Metal Recovery Industries, Dofasco Inc. and Stelco Inc.

Dofasco Inc. and **Stelco Inc.**, located in Hamilton, Ontario have a joint venture in the recycling of food and beverage cans. They pay $70/tonne for loose or flattened cans and $90/tonne for baled cans (75 lb/ft^3) delivered to their facilities. They will pay an additional $15/tonne for the first 400 tonnes delivered or for the first year of a start-up operation supply. The shipping cost must be paid by the supplier. The cost of shipping tinned cans from New Brunswick to Hamilton, Ontario has made it uneconomical to recycle steel cans in New Brunswick. However, officials from Dofasco Inc. indicated that they are in the process of negotiating with Centrecord Quebec (affiliated with Stelco Inc.) to serve as a drop-off centre for cans collected by eastern Canadians. The shipping costs to Quebec may be less, therefore increasing the potential for collection of tinned cans in New Brunswick.

2.5.7 Tires

The disposal of old tires has become a large problem in North America. Landfill operators do not want to accept old tires because they do not stay buried and they take up too much space in the landfill. This and the lack of market for old tires has caused the stockpiling of tires across the country.

Several research projects are underway to determine and develop the market for recycled tires. These projects include the use of recycled tire rubber to manufacture new rubber products such as doormats, muffler hangers, hoses, hockey pucks and underground piping for use in agriculture drainage system. The use of rubber tire chips, as a substitute for wood in processing sewage sludge at composting facilities and the resale to manufacture new tires, is also being considered. Potentially the biggest market for recycled tires would be in highway pavement and other roadway applications. Road applications require that the rubber from tires be in crumb form to be manufacturable. Although, there is a marginal improvement in asphalt quality, the costs are substantially higher to use rubber/asphalt (Anon, 1990). The market for shredded tires is very limited; it may be used for overburden on landfills.

The major problem associated with recycling tires is the inability to separate the various products in the tires, such as steel.

Resource Recovery Orangeville, located in Orangeville, Ontario recycles old tires. They are producing a crumb which is sold to a variety of rubber product manufacturers. They charge $1.84 for each tire delivered to their facility.

Achiever Tire, located in Mississauga, Ontario collects approximately 100,000 tires/month. They charge $1.84 for car tires and $3.21 for truck tires. Until recently they were the raw material supplier for Technitred in Glace Bay, N.S. Technitred has since ceased operations.

2.5.8 Scrap Metals

The solid waste stream contains small amounts of miscellaneous scrap metals that may be recycled. For example, Cyclomet in Scoudouc, New Brunswick collects auto bodies and white goods. **Table 2.8** presents the type of metals and miscellaneous products that are collected by local brokers and the range of prices that are paid for each commodity.

TABLE 2.8

MISCELLANEOUS SCRAP METAL PRODUCTS

Product	Price - $/tonne
Copper - #1 grade	2200
Copper = #2 grade	1700 - 1900
Red Brass	1540 - 1650
Yellow Brass	1100
Stainless Steel	500 - 660
Scrap Steel	30 - 40
Lead	330
Army aluminum	110-220
Clean Aluminum	660 - 770
Radiators	1000 - 1100
Batteries	1.25*
White Goods	5.00

* unit price

A summary of the potential recyclable commodities in New Brunswick, the shipping specifications and the purchase price are listed below in **Table 2.9**. The specifications include bale size and density and minimum contamination levels. The price indicated is the price paid for the commodities delivered to the various market facilities.

2.6 Compost Markets

A study on the role of composting in municipal solid waste management was recently completed by the Environmental Sciences Research Centre of the Université de Moncton (1990), which reviewed the potential markets for compost. This study included information on composting options (municipal solid waste, sewage sludge, and co-composting industrial food waste), public perception, marketability of compost products in New Brunswick and the economic feasibility of composting.

As part of the Université de Moncton study, WMS Associates Ltd. conducted a survey of individuals and commercial establishments to assess the potential for the sale of compost products in New Brunswick. Two markets, the domestic market and the commercial/institutional market, were targeted. The surveys were designed to determine the role of compost vis-a-vis other comparable soil

TABLE 2.9

MARKET SUMMARY

PRODUCT	MARKET	SPECIFICATION	$/TONNE
Newsprint	Fraser Inc. Edmundston, NB	Minimum 1000 lb bales Dry and clean	$60
	Laidlaw Resources Burlington, ON	10-year contracts Minimum 10,000 tonne/ yr	$27.50
	Quebec and Ontario Paper Ltd. Thorold, On	Baled Dry and clean	$30-40 + shipping
	Abitibi-Price Inc. Chandler, PQ	Baled Dry and clean	$40 + shipping
	Thermocell Insulation Ltd. Debert, NS	Dry and free of glossy paper	$30-35
	Canbrand International Ltd. Moncton, NB	Cleaned, baled	$40
	NB Farmer for Cattle Bedding	Clean, flyer free	$40
Old Corrugated Cardboard	Stone-Consolidated Inc. Bathurst, NB	Baled, Clean - no glue - no tape	$30-35
	Lake Utopia Paper Limited, Lake Utopia, NB	Will purchase only from Saint John Recycling	$55-110
	Minas Basin Pulp & Power Company Hantsport, NS	Will purchase only from from Scotia Recycling	$44
Boxboard	Fraser Inc. Edmundston, NB	Baled Minimum shipment of 20 tonnes	$35-60
Fine Paper	Cascades Inc. Kingsley Falls, Quebec	Baled	$5-250
Directories	Laidlow Environmental Services		none
	Uthane Research Limited	On skids	none
HDPE	Dupont Canada Montreal, PQ	Baled <3% contamination by wt	$140

Table 2.9 (Cont'd)

Market Summary

PRODUCT	MARKET	SPECIFICATION	$/TONNE
Mixed Plastic	Superwood Ontario Ltd. Mississauga, ON	Baled	$60
Glass	Ryan Investments Moncton, NB	Colour sorted	$43.50
	Archie Fader Sackville, NB	Colour sorted	$43.50
	Shediac Pallet Ltd. Shediac, NB	Colour sorted	$43.50
	Péloquin Recyclage Montreal, PQ		$38-44
Aluminum	Fri-Metal Recycling Fredericton, NB		$660
	Maritime Recycling Fredericton, NB		$770
	Péloquin Recyclage Montreal, PQ		$600-800
	Alcan Recycling Canada Montreal, PQ		$1,060
PET	Twinpac Inc. Ontario	Baled, clean	
		< 30,000 lb (shipment)	$200
		> 30,000 lb (shipment)	$300
	Péloquin Recyclage Montreal, PQ	Will only accept from deposit refund program	$175
		Blue Box Program	$77-88
Plastic Film	PCL and Eastern Packaging Ltd. Saint John, NB	Loose or baled	$440
Steel Cans	Dofasco Inc. Hamilton, ON	Loose, flattened	$70
		Baled (75 lb/ft^3)	$90
	Stelco Inc. Hamilton, On	Loose, flattened	$70
		Baled (75 lb/ft^3)	$90
Polystyrene	Plastic Again Leominster, MASS	Baled < 2% contamination	$100 US

enhancement products. It identified public perception regarding various sources of compost (sludge, leaves, municipal solid waste), product quality (consistency and waster retention), availability and price, as important factors considered when purchasing or using soil enhancers. The survey determined that the ultimate use of compost will depend upon its quality.

The domestic market survey identified the residential gardener as a potential user of compost. The domestic gardener may use compost as an amendment to improve organic and nutrient content of the soil, a mulch to improve water retention and inhibit weed growth, or as a top dressing to improve appearance of the soil. The WMS Associates Ltd. survey indicated that the market for compost to the home gardener is growing rapidly in New Brunswick; however, no information was provided on the actual market size or market value of compost.

The commercial/institutional users of bulk compost identified include developers of land reclamation projects, public agencies and municipalities, nurseries and landscapers. The survey indicated that although the potential quantities may be greater than the domestic market, these users must be assured that a consistently high quality product is available. The present size of this market in New Brunswick is thought to be small; however, a growing awareness of environmental concerns may place limitations on current topsoil supplies (i.e. the stripping of land for topsoil) and may create a demand for compost.

A few compost operations were surveyed for this study. The City of Fredericton is presently composting leaves, manure, sewage sludge and potato waste. The leaf/manure compost is used primarily in flower beds. The compost made from sewage sludge, culled potatoes, leaves and manure is used as topsoil in the construction and maintenance of parks and cemeteries. It costs the City approximately $30 to produce one tonne of compost. This price does not include the amount saved from not paying the tipping fee at the landfill. If the compost was not available, the City would pay $200/tonne for peat moss and $9.60/tonne for topsoil.

The Engineering and Works Department, Parks and Ground Division in Halifax, Nova Scotia, composts 4,500 tonnes of leaves and 1,500 tonnes of wood a year. From these, it produces 1,200 tonnes of compost, which costs them between $13-14 per tonne. The compost produced by Parks and Ground Division is used largely as a supplement to peat moss. The use of the compost saves the City of Halifax $150,000 a year in soil and tipping fee costs.

Maritime Sod Limited in Saint John, New Brunswick produces a topsoil material. The company composts sludge from the local pulp mill and mixes it with sand to make their topsoil product. A company representative indicated that there is a market for compost as a supplement to topsoil (1/6 compost, 5/6 topsoil).

The markets available for compost depends upon four key factors: 1) quality of the compost; 2) quantity of compost available; 3) local horticultural industries; and 4) price.

Quality control and product consistency are very important factors in the market development of compost materials. There is no long-term market viability for a compost product that is not consistent (pers communication with Bob Arsenault of Maritime Soil Limited; Stephen King, of the city of Halifax).

The quantity of compost available is an important factor in marketing to large scale and consistent users. Land reclamation projects may require a single large quantity of compost for one project, but may not require it on a continual basis. The quantity of compost required by domestic users may be significantly smaller than land reclamation users. Their demand would be seasonal, i.e. during the growing season (May-August).

In order to estimate the potential market price for compost, two scenarios were assessed: 1) replacement for peat moss and topsoil; and 2) giving it away because of lack of market. The price of compost must be competitive to other comparable and/or replacement products (primarily peat moss at $200/tonne and topsoil at $9.60/tonne). The low end of the price scale would be to give the compost away ($0/tonne) on a "you pick-up" basis, or use as cover material at the landfill site.

3.0 CENTRAL PROCESSING FACILITIES AND SERVICE AREAS

3.0 CENTRAL PROCESSING FACILITIES AND SERVICE AREAS

This chapter addresses two aspects of the regional central processing facility (CPF) concept, as applied to the Province of New Brunswick. The first involves the designation and selection of CPF service areas to most efficiently serve the entire Province with large scale recycling system options based on the trade-off between plant scale economies and line haul transportation costs. The other aspect is the preliminary conceptual design and capital and operating cost estimates of CPF's, and similarly Maximized Recycling Facilities (MaxRF's) wet-dry recycling systems.

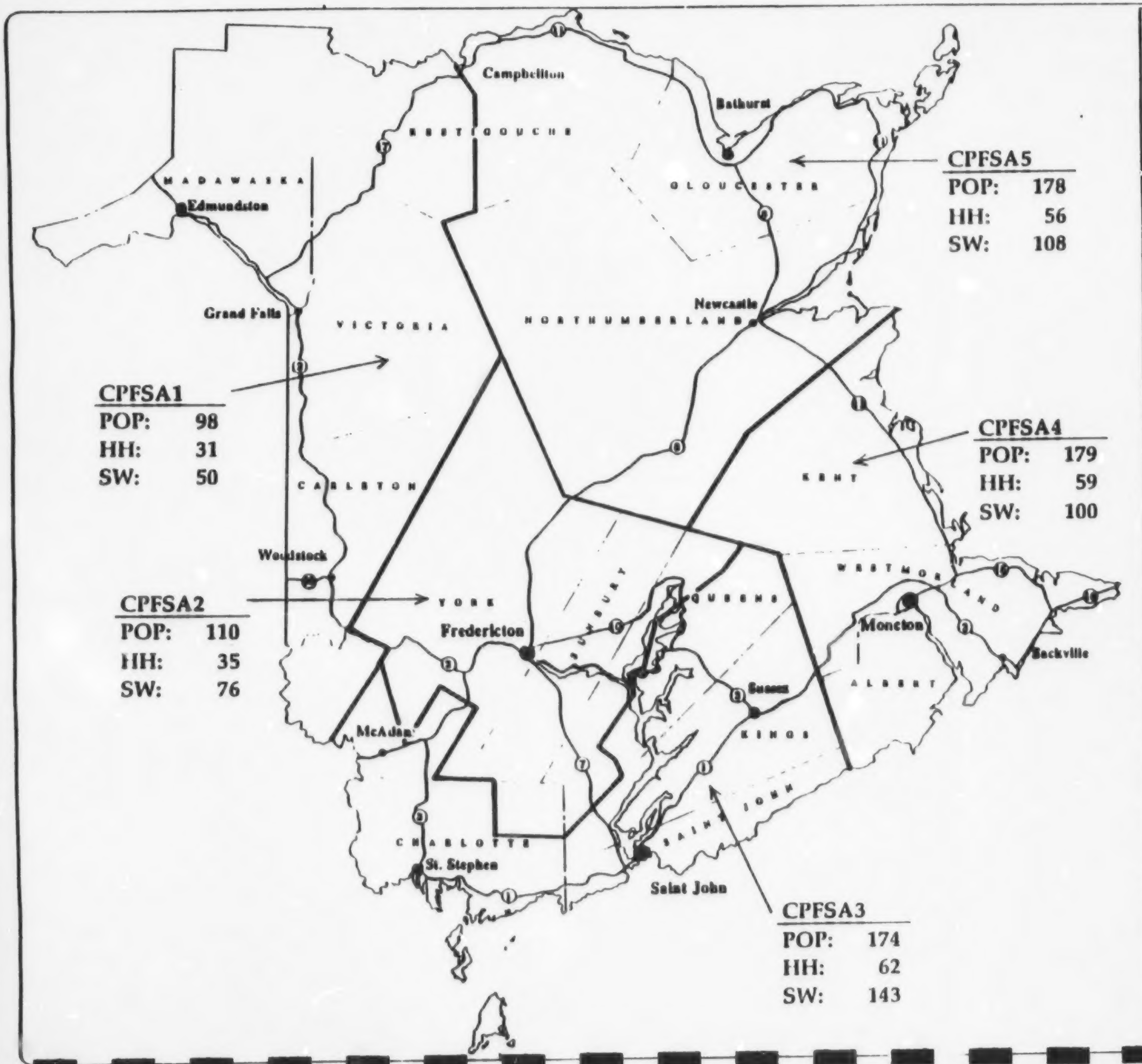
3.1 CPF Service Area Selection

One of the tasks of this study was to establish the most cost efficient geographic and demographic configuration of regions in New Brunswick to be served by the large scale CPF recycling systems. The objective of this analysis was to select the most cost efficient CPF Service Area Scenario to be used in the detailed analyses reported in **Chapter 5.0** of this study.

Four CPF service area scenario's were developed for the selection analysis:

1. Scenario 1A - the Province divided into 5 CPF service areas, as shown in **Figure 3.1**;
2. Scenario 1B - the Province divided into 5 CPF service areas, as shown in **Figure 3.2**;
3. Scenario 2 - the Province divided into 7 CPF services areas, as shown in **Figure 3.3**; and
4. Scenario 3 - the Province divided into 12 CPF Service areas, as shown in **Figure 3.4**.

The demographic (ie. Population and Households) and Residential and ICI wastes generated data are provided in **Table 3.1** for the four CPF Service Area Scenarios. The designation of the CPF Service Areas in all scenarios conformed with established SWM Region boundaries. Parts of the Province not designated within


Campbellton
Bathurst
MADAWASKA
Edmundston
RESTIGOUCHE
GLOUCESTER
Grand Falls
VICTORIA
NORTHUMBERLAND
Newcastle
CARLETON
KENT
Woodstock
YORK
SUNBURY
QUEENS
WESTMORLAND
Moncton
Sackville
Fredericton
Sussex
ALBERT
KINGS
McAdam
CHARLOTTE
St. Stephen
SAINT JOHN
Saint John
CPFSA1
POP: 98
HH: 31
SW: 50
CPFSA2
POP: 110
HH: 35
SW: 76
CPFSA3
POP: 174
HH: 62
SW: 143
CPFSA4
POP: 179
HH: 59
SW: 100
CPFSA5
POP: 178
HH: 56
SW: 108

Legend

CPF Central Processing Facility Area

POP: population in '000

HH: households in '000

SW: solid waste in '000 tonnes

FIGURE 3.1

FGA FIANDER-GOOD ASSOCIATES LTD.

Project Title:
NB RECYCLING PLAN

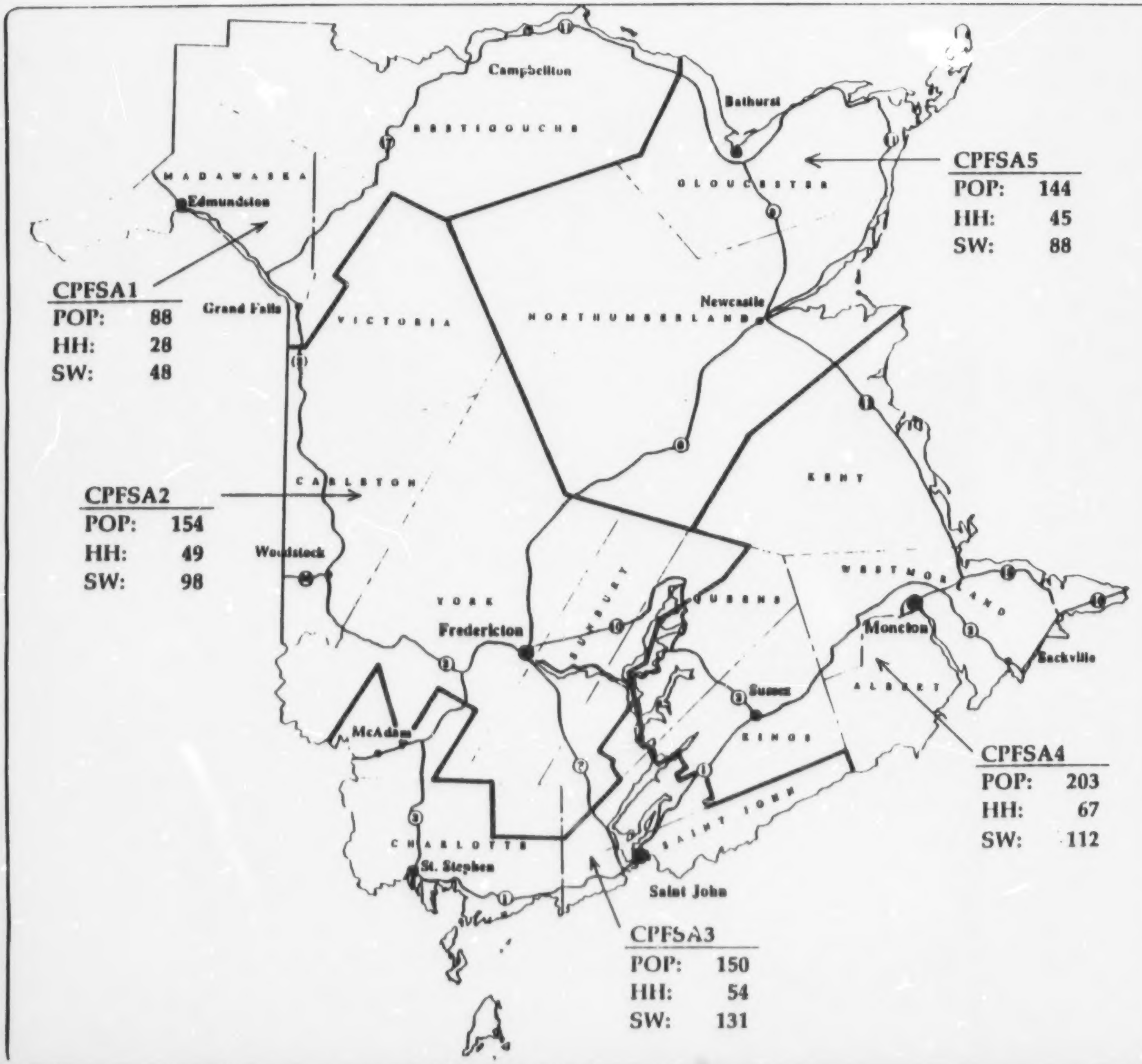
Drawing Title:
SCENARIO 1A:
5 CPF SERVICE AREAS

Scale:
not to scale

Date:
June, 1991

Drawn by:
JTGB

Job No:
612 01


Campbellton
RESTIGOUCHE
Bathurst
MADAWASKA
Edmundston
GLOUCESTER
CPFSA5
POP: 144
HH: 45
SW: 88
CPFSA1
POP: 88
HH: 28
SW: 48
Grand Falls
VICTORIA
NORTHUMBERLAND
Newcastle
CARLETON
KENT
CPFSA2
POP: 154
HH: 49
SW: 98
Woodstock
YORK
Fredericton
SUNBURY
QUEENS
WESTMORLAND
Moncton
Sackville
Sussex
ALBERT
KINGS
McAdam
CPFSA4
POP: 203
HH: 67
SW: 112
SAINT JOHN
CHARLOTTE
St. Stephen
Saint John
CPFSA3
POP: 150
HH: 54
SW: 131

Legend

CPF Central Processing Facility Area

POP: population in '000

HH: households in '000

SW: solid waste in '000 tonnes

FIGURE 3.2

FGA FIANDER-GOOD ASSOCIATES LTD.

Project Title: NB RECYCLING PLAN

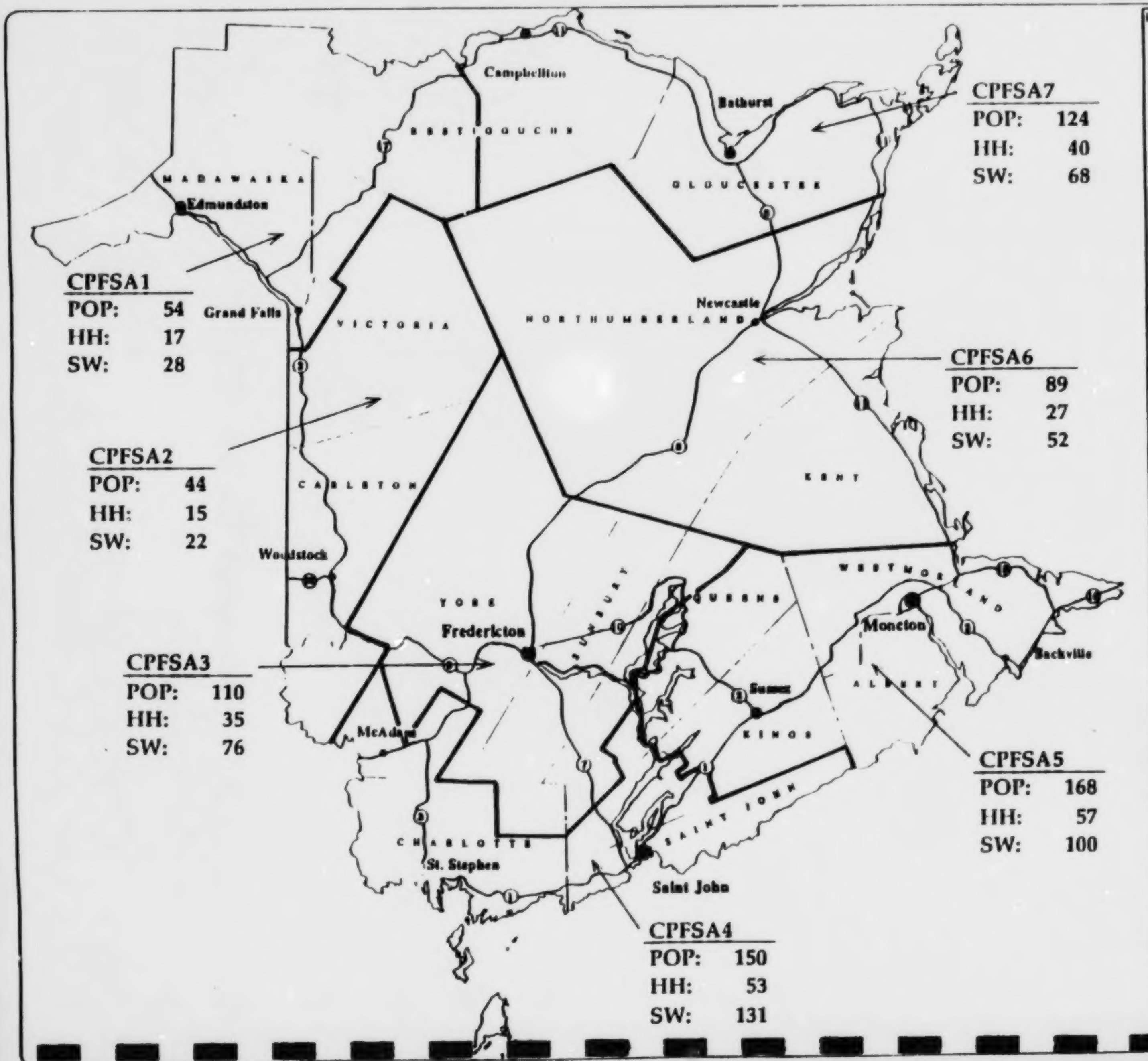
Drawing Title: SCENARIO IB: 5 CPF SERVICE AREAS

Scale: not to scale

Date: June, 1991

Drawn by: JTGB

Job No: 612-04


Campbellton
Bathurst
RESTIGOUCHE
MADAWASKA
Edmundston
GLOUCESTER
Grand Falls
VICTORIA
NORTHUMBERLAND
Newcastle
CARLETON
KENT
Woodstock
YORK
SUNBURY
QUEENS
WESTMORLAND
Fredericton
Moncton
Sackville
Sussex
ALBERT
KINGS
McAdam
CHARLOTTE
St. Stephen
SAINT JOHN
Saint John
CPFSA1
POP: 54
HH: 17
SW: 28
CPFSA2
POP: 44
HH: 15
SW: 22
CPFSA3
POP: 110
HH: 35
SW: 76
CPFSA4
POP: 150
HH: 53
SW: 131
CPFSA5
POP: 168
HH: 57
SW: 100
CPFSA6
POP: 89
HH: 27
SW: 52
CPFSA7
POP: 124
HH: 40
SW: 68

Legend

CPF Central Processing Facility Area

POP: population in '000

HH: households in '000

SW: solid waste in '000 tonnes

FIGURE 3.3

FGA FIANDER-GOOD ASSOCIATES LTD.

Project Title: NB RECYCLING PLAN

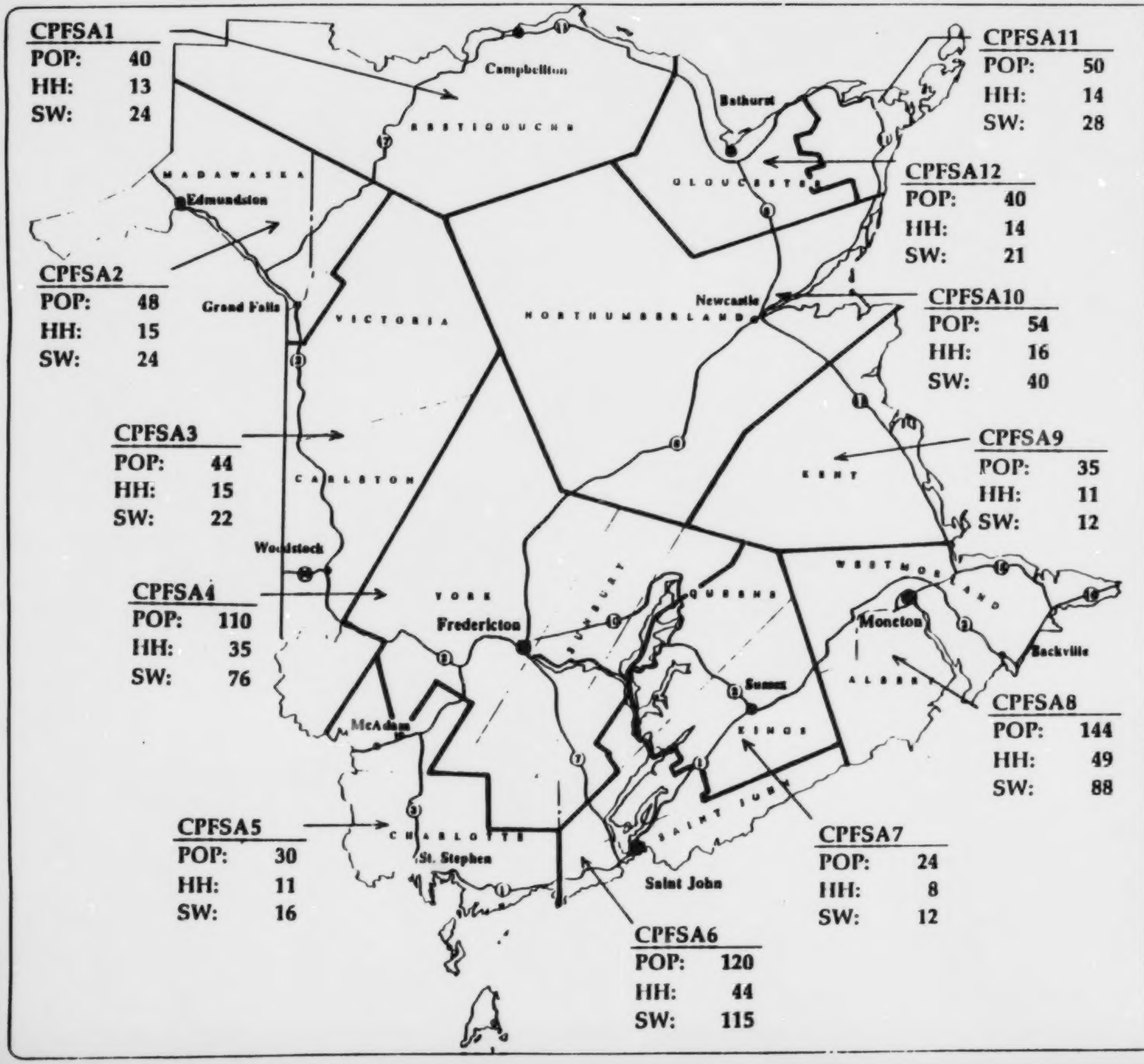
Drawing Title: SCENARIO 2: 7 CPF SERVICE AREAS

Scale: not to scale

Date: June, 1991

Drawn by: FTGB

Job No: 612-01


CPFSA1
POP: 40
HH: 13
SW: 24
CPFSA2
POP: 48
HH: 15
SW: 24
CPFSA3
POP: 44
HH: 15
SW: 22
CPFSA4
POP: 110
HH: 35
SW: 76
CPFSA5
POP: 30
HH: 11
SW: 16
CPFSA6
POP: 120
HH: 44
SW: 115
CPFSA7
POP: 24
HH: 8
SW: 12
CPFSA8
POP: 144
HH: 49
SW: 88
CPFSA9
POP: 35
HH: 11
SW: 12
CPFSA10
POP: 54
HH: 16
SW: 40
CPFSA11
POP: 50
HH: 14
SW: 28
CPFSA12
POP: 40
HH: 14
SW: 21
Campbellton
RESTIGOUCHE
Bathurst
GLOUCESTER
MADAWASKA
Edmundston
Grand Falls
VICTORIA
NORTHUMBERLAND
Newcastle
CARLETON
KENT
Woodstock
YORK
Fredericton
SUNBURY
QUEENS
WESTMORLAND
Moncton
Sackville
Sussex
ALBERT
KINGS
McAdam
CHARLOTTE
St. Stephen
SAINT JOHN
Saint John

Legend

CPF Central Processing Facility Area

POP: population in '000

HH: households in '000

SW: solid waste in '000 tonnes

FIGURE 3.4

FGA FIANDER-GOOD ASSOCIATES LTD.

Project Title:
NB RECYCLING PLAN

Drawing Title:
SCENARIO 3:
12 CPF SERVICE AREAS

Scale:	Date:
not to scale	June, 1991
Drawn by:	Job No:
JTGB	612 01

Table 3.1
CPF Service Area Scenarios Data

Scenario	Regions	Population	Households	Total Solid Waste (tonnes)	Residential Solid Waste (tonnes)	ICI Solid Waste (tonnes)
1A	Madawaska/Victoria (Restigouche), Carleton/Victoria (York)	97,598	31,462	49,967	28,925	21,042
	Fredericton (York, Sunbury, Queens)	110,360	34,900	75,486	41,374	34,112
	Fundy (Queens), Kings (Queens), Charlotte	174,370	62,291	142,991	71,826	71,165
	Kent, Westmorland/Albert	178,840	59,205	99,844	45,743	54,101
	Restigouche, Nepisiguit/Chaleur, Acadian Peninsula, Northumberland	178,219	55,656	108,301	51,817	56,484
1B	Madawaska/Victoria, Restigouche (Rest	87,798	27,807	47,707	26,545	21,162
	Fredericton (York, Sunbury, Queens), Carleton/Victoria (York)	154,040	49,400	97,894	54,433	43,461
	Fundy (Queens), Charlotte	150,015	54,346	130,698	64,973	65,725
	Kent, Westmorland/Albert, Kings (Queens)	203,195	67,150	112,137	52,596	59,541
	Nepisiguit/Chaleur, Northumberland Acadian Peninsula	144,338	44,812	88,153	41,138	47,015

Table 3.1 (cont'd)

CPF Service Area Scenarios Data

Scenario	Regions	Population	Households	Total Solid Waste (tonnes)	Residential Solid Waste (tonnes)	ICI Solid Waste (tonnes)
2	**Madawaska/Victoria (Restigouche)**	53,918	16,962	27,559	15,866	11,693
	Carleton/Victoria (York)	43,680	14,500	22,408	13,059	9,349
	Fredericton (York, Sunbury, Queens)	110,360	34,900	75,486	41,374	34,112
	Fundy (Queens), Charlotte	150,015	54,346	130,698	64,973	65,725
	Westmorland/Albert, Kings (Queens)	168,415	56,525	100,332	45,590	54,742
	Northumberland, Kent	88,680	26,750	51,853	20,094	31,759
	Restigouche, Nepisiguit/Chaleur, Acadian Peninsula	124,319	39,531	68,253	38,729	29,524
3	**Restigouche (Restigouche)**	40,110	12,705	23,852	12,642	11,210
	Madawaska/Victoria	47,688	15,102	23,855	13,903	9,952
	Carleton/Victoria (York)	43,680	14,500	22,408	13,059	9,349
	Fredericton (York, Sunbury, Queens)	110,360	34,900	75,486	41,374	34,112
	Charlotte	30,400	10,780	15,595	9,090	6,505
	Fundy (Queens)	119,615	43,566	115,103	55,883	59,220
	Kings (Queens)	24,355	7,945	12,293	6,853	5,440
	Westmorland/Albert	144,060	48,580	88,039	38,737	49,302
	Kent	34,780	10,625	11,805	7,006	4,799
	Northumberland	53,900	16,125	40,048	13,088	26,960
	Acadian Peninsula	50,423	14,407	27,587	16,078	11,509
	Nepisiguit/Chaleur	40,015	14,280	20,518	11,972	8,546

any established SWM Region were allocated to adjacent regions by the Study Team.

Centres of waste generation were determined for each CPF service area of each CPF Service Area Scenario using the Centre of Waste Generation component of the NBDOE SWATMODEL (Solid Waste Transportation Model). It was assumed that the CPF's or MaxRF's would be located at the centres of generation of each CPF Service Area, or at existing regional landfill sites in Fredericton and Nepisiguit/Chaleur, in all four CPF Service Area Scenarios. This assumption was made because most of the regions have not selected a regional waste disposal site, nor have they considered a site for a CPF. Since the CPF's and MaxRF's are fully enclosed and environmentally controlled facilities, they would not necessarily need to be located at a regional disposal site. They are not restricted by physical and many of the environmental constraints on landfill disposal sites, and could be located in industrial parks in urban areas, or in rural areas, etc. Therefore, the Centres of Generation serve as a good starting point for the CPF site location search process. The Centres of Generation of the prospective CPF Service Areas provide a "benchmark" indicating the least-cost location of a CPF, so they were used in this analysis.

The cost analysis of the four CPF Service Area Scenarios was performed using preliminary CPF plant capital and operating cost estimates combined with the estimated line haul transportation costs of delivering recyclable materials to the CPF. These basic cost components established the trade-off between plant scale and transportation system economies.

It should be noted that the costs used in this analysis were preliminary for use in this CPF Service Area Scenario Selection analysis. The cost of CPF's of varying scales and operations are provided in detail along with their conceptual design later in this chapter. The transportation line haul costs exclude the costs incurred while on the recyclable collection route, and reflect only the delivery to and from the collection zone to the CPF. However, it is the line haul transportation cost component that will vary the most according to relative distances between the collection zone routes and CPF locations. So to reduce the analytical complexity, only line haul costs were used in this CPF Service Area Scenario selection analysis. The complete range of collection system options, costs are provided in **Chapter 4.0**, and the collection system options costs are provided in **Chapter 5.0**.

The CPF Service Area Scenario selection analysis showed that 5 CPF's serving the Province as designated by Scenario 1A (see **Figure** 3.1) resulted in the least-cost combination of plant and line haul transportation costs. The combined costs of Scenario 1A ranged between $7.7 and $9.9 million per annum for the entire Province depending upon recyclables diversion levels. Scenario 1B, which divides the Province into 5 different CPF service areas (see **Figure** 3.2) resulted in slightly higher cost by 2 to 3% than Scenario 1A. Scenario 2 (see **Figure** 3.3) costs were 10 to 18% higher and Scenario 3 (see **Figure** 3.4) costs were 43 to 74% higher than Scenario 1A.

Given the efficiencies realized by the scenarios with five larger service areas, CPF Service Area Scenarios 1A and 1B, the potential for further economies by dividing the Province into less than 5 service areas was examined. However, it was established that further plant scale economies were minimal, whereas net increases in line haul transportation costs of delivering the recyclable materials were far in excess of any further net reduction in plant costs. Dividing the Province into 5 CPF service areas proved to be the most cost efficient for serving the Province by large scale CPF's. While the cost difference between CPF Service Area Scenario 1A and 1B was minor, Scenario 1A was slightly less; so it was decided that CPF Service Area Scenario 1A be used throughout the remainder of the study.

3.2 Centralized Processing Facilities

The study team evaluated three different capacity Centralized Processing Facilities (CPF's) and two different Maximized Recycling Facilities (MaxRF's) based on preliminary estimates of the available quantities of recyclables generated from each of the proposed CPF Service Areas. The initial design assumptions were that the facilities would be operated on a single 8 hour operating shift and would be capable of processing source separated materials from both the residential and ICI sectors. The purpose of the preliminary conceptual design and cost estimates of the different facilities was to provide a range of costs for use with the cost sensitivity analysis of plant versus line haul transportation costs to select the best CPF Service Area Scenario, as presented in the previous section.

The facilities have been developed based on a range of recyclable material recovery levels and composition of the materials to be processed. The critical variables in the design of the processing facilities are as follows: The ratio of commercial to residential wastes; the level of source separation of the material; the hourly throughput volume requirement; and, the variety of the materials to be processed. All of the CPF's evaluated include separate processing arrangements for mixed recyclable containers and source separated ICI materials and residential fibre materials (ie. papers and cardboard).

Once the CPF Service Area scenario selection analysis was finalized the CPF's were looked at in greater detail to determine the most appropriate match of facility capacity to each CPF service area, and to ascertain if a sufficient variation in throughput capacity had been provided with the 3 CPF's. The application of cost economies of each of the facilities under two and three shift operating conditions was also evaluated. It was determined that under some of the low recyclables diversion scenarios the required capacities of the CPF's would be highly under utilized. This was the case with the drop-off depot recycling system options for residential recycling. To fill the gap under the low recyclable materials diversion scenarios a fourth CPF was developed to accommodate low annual volume waste collection scenarios achieved by drop-off depot recycling systems to facilitate the bulking of materials collected for shipment to market.

3.2.1 Facility Cost Estimates

A comprehensive review of the available mixed recyclables sorting technologies was undertaken as the first step in estimating facility costs. With the exception of the Material Bulking Facility it was assumed that all of the CPF's would have the capability of processing fully commingled materials including glass mixed with other container fractions. The review of available technology and preliminary cost comparison yielded 3 different capacity commingled processing systems, which correspond to the estimated hourly throughput capacities required for the CPF service areas. These systems all have virtually the same type of separation equipment however, the size and the labour requirements vary according to the quantity and number of materials being processed. The fibre (ie. papers) processing systems are dependent on manual hand sorting rather than mechanical sorting technology. The key processing consideration for the fibre sorting systems was the capacity in tonnes per hour of the baler.

For all facilities it was assumed that no more than one and one half days storage of collected material would be provided on the tipping floor. In addition it was assumed that the storage area for baled products and other processed materials would be adequate for a maximum of one week. The capacities, size, general equipment list and average operating cost per one shift capital cost are detailed for each of the 3 CPF's and the Material Bulking Facility as follows in **Table 3.2**:

3.2.2 Facility Description - Selected Central Processing Facilities

The conceptual processes representative of the 3 CPF's depicted by the 100 tonne per day facility, and the Material Bulking Facility are presented in this section. The 100 tonne per day CPF is equivalent to CPF #1, but the process flow and layout are essentially the same for the two larger CPF's. Only the capacity of the equipment building size and manpower requirements vary.

3.2.2.1 100 Tonne per Day Central Processing Facility 1

Figures 3.5 and **3.6** illustrate the conceptual process flow and general plant layout, respectively, for the 100 tonne per day CPF. Recyclable materials are delivered to this facility by specially designed compartmentalized collection vehicles. This facility is also capable of processing materials which are collected in the form of separated glass, plastics and cans.

The characteristics of the recyclable materials processed generally dictate two separate process lines. One line is configured to process the light fraction of the recyclables including newspaper, cardboard, mixed paper and plastic film. The second line is designed for the separation of various types and sizes of containers comprised of glass, aluminum steel and plastic.

The order in which materials are stored on the collection vehicle will dictate the tipping order at the processing facility. Newspaper is tipped directly onto the receiving floor adjacent to the in-floor feed conveyor and push wall. The material is then pushed by a front-end loader onto the feed conveyor where it is conveyed up to the elevated sorting platform and picking stations. Manual sorting pulls out contaminants and drops them down into storage bunkers beneath the sorting stations. It is critical that these materials storage bunkers be sized with adequate capacity to store enough material to make a full bale. The concept of separating sorting from baling operations maximizes the availability and efficiency of the baler. The best approach is to follow a negative sort, i.e., remove contaminants

TABLE 3.2

CPF OPTIONS COSTS

1. CENTRAL PROCESSING FACILITY #1

Approximate Building Size	-2320m^2 (25,000 ft^2) -50% storage Capacity on Transfer Trailers
Annual Throughput Capacity	-5,250 tonnes single shift mixed recyclables -17,500 tonnes single shift fibre materials

AREA DESCRIPTION	ESTIMATED COST
Mixed Recyclables Sorting Line	$250,000
Fibre Materials Sorting Line	$180,000
Baler and Feed Conveyor	$380,000
2-Bobcats/Forklift	$150,000
Recovered Material Bins	$20,000
Weighscale (inc. Foundation)	$120,000
Building Estimate	$1,600,000
Subtotal Capital Cost	$2,700,000
Contingencies	$300,000
TOTAL CAPITAL COST	$3,000,000
ESTIMATED ANNUAL OPERATING COST	$600,361
AMORTIZED CAPITAL COST[1]	$397,620

2. CENTRAL PROCESSING FACILITY #2

Approximate Building Size	-3720m^2 (40,000 ft^2) -10% storage Capacity on Transfer Trailers
Annual Throughput Capacity	-10,500 tonnes single shift mixed recyclables -26,250 tonnes single shift fibre materials

AREA DESCRIPTION	ESTIMATED COST
Mixed Recyclables Sorting Line	$400,000
Fibre Materials Sorting Line	$250,000
Fine Paper Sorting Line	$75,000
Baler and Feed Conveyor	$490,000
2-Bobcats/Forklift	$150,000
Recovered Material Bins	$30,000
Weighscale (inc. Foundation)	$120,000
Building Estimate	$2,200,000
Subtotal Capital Cost	$3,640,000
Contingencies	$360,000
TOTAL CAPITAL COST	$4,000,000
ESTIMATED ANNUAL OPERATING COST	$823,499
AMORTIZED CAPITAL COST[1]	$524,370

---

[1] Amortized capital costs are at 12 percent interest over 15 years.

Table 3.2 (Cont'd)

3. CENTRAL PROCESSING FACILITY #3

Approximate Building Size	-6040m^2 (65,000 ft^2) -10% storage Capacity on Transfer Trailers
Annual Throughput Capacity	-17,500 tonnes single shift mixed recyclables -43,750 tonnes single shift fibre materials

AREA DESCRIPTION	ESTIMATED COST
Mixed Recyclables Sorting Line	$800,000
Fibre Materials Sorting Line	$250,000
Baler and Feed Conveyor	$490,000
Baler and Feed Conveyor	$380,000
Fine Paper Sorting Line	$75,000
2-Bobcats/2-Forklifts	$200,000
Recovered Material Bins	$40,000
Weighscale (inc. Foundation)	$120,000
Building Estimate	$3,200,000
Subtotal Capital Cost	$5,555,000
Contingencies	$555,000
TOTAL CAPITAL COST	**$6,110,000**
ESTIMATED ANNUAL OPERATING COST	**$1,281,009**
AMORTIZED CAPITAL COST[1]	**$800,980**

4. CENTRAL PROCESSING FACILITY #4 (MATERIALS BULKING FACILITY)

Approximate Building Size	-600-800m^2
Annual Throughput Capacity	-typically less than 7500 tonnes

AREA DESCRIPTION	ESTIMATED COST
Mixed Recyclables Sorting Tables	$10,000
Baler W/O Feed Conveyor	$135,000
Bobcat/Forklift	$100,000
Recovered Material Bins	$20,000
Weighscale (inc. Foundation)	$120,000
Building Estimate	$600,000
Subtotal Capital Cost	$985,000
Contingencies	$100,000
TOTAL CAPITAL COST	**$1,085,000**
ESTIMATED ANNUAL OPERATING COST	**$385,000**
AMORTIZED CAPITAL COST[1]	**$145,060**

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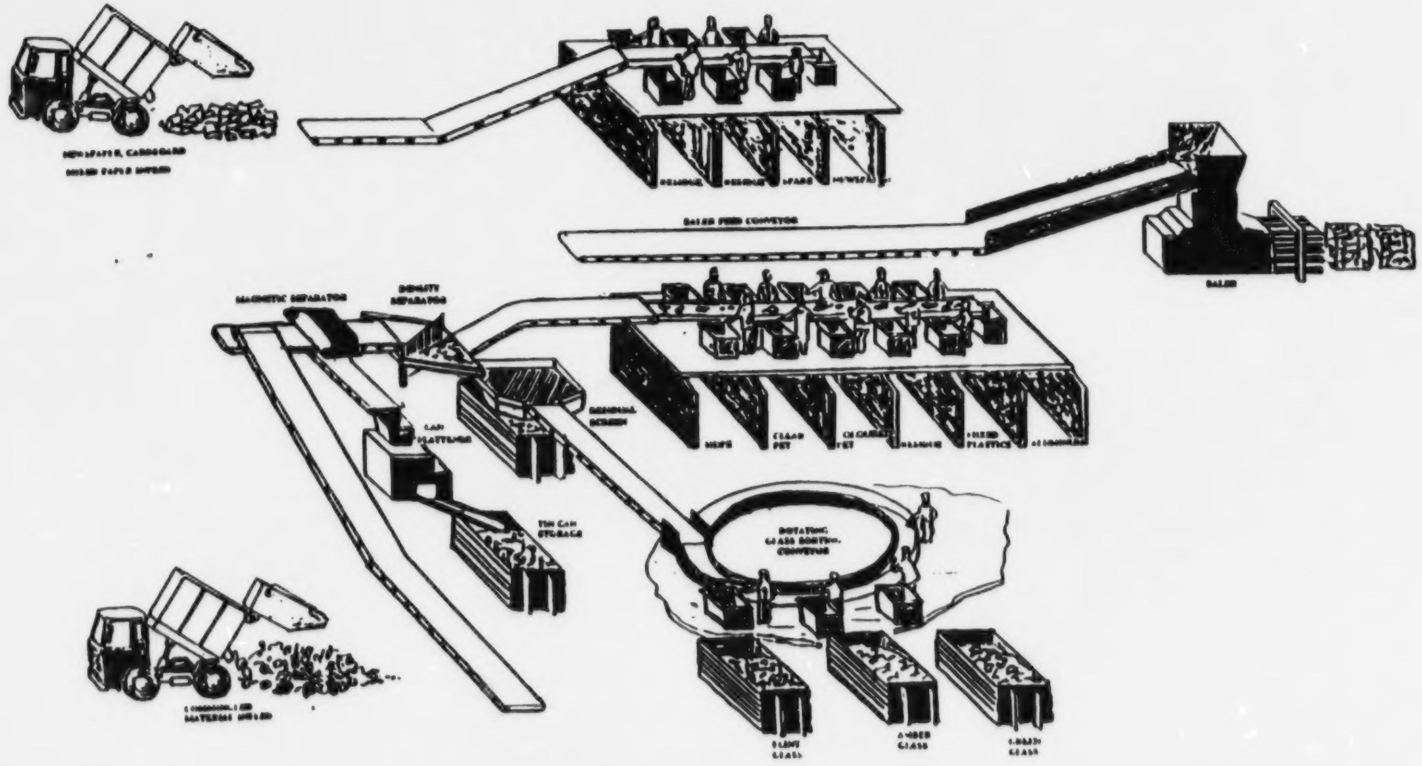
[1] Amortized capital costs are at 12 percent interest over 15 years.


NEWSPAPER, CARDBOARD
MIXED PAPER DUMPED
RESIDUE
RESIDUE
SPARE
NEWSPAPER
BALER FEED CONVEYOR
BALER
MAGNETIC SEPARATOR
DENSITY SEPARATOR
TROMMEL SCREEN
CAN FLATTENER
HDPE
CLEAR PET
COLOURED PET
RESIDUE
MIXED PLASTICS
ALUMINUM
TIN CAN STORAGE
ROTATING GLASS SORTING CONVEYOR
FLINT GLASS
AMBER GLASS
GREEN GLASS
COMMINGLED MATERIALS DUMPED

NOTES

SCALE: NTS
DES
DRWN
CHKD
APPD

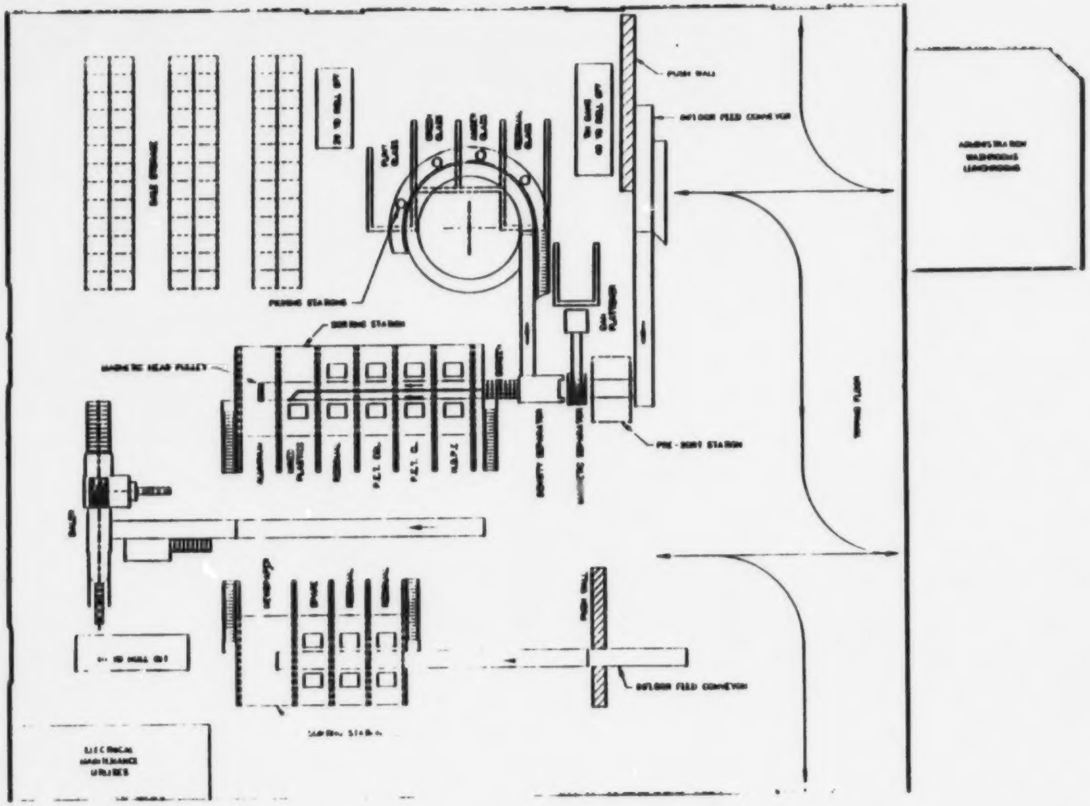
DATE: 04/91

R. CAVE
AND
ASSOCIATES
LTD
CONSULTING ENGINEERS

TITLE

FIGURE 3.5
CONCEPTUAL PROCESS FLOW
100 TONNES/DAY CPF

DWG NO


BALE STORAGE
PUSH WALL
INFLOOR FEED CONVEYOR
ADMINISTRATION
WASHROOMS
LUNCHROOMS
PICKING STATIONS
SORTING STATION
MAGNETIC HEAD PULLEY
PRE-SORT STATION
P.E.T. CL.
P.E.T. G.
H.D.P.E.
BALER
OUTDOOR FEED CONVEYOR
SORTING STATION
ELECTRICAL
MAINTENANCE
UTILITIES

2300 m^2 (TYP)

NOTES

SCALE: NTS
DES
DRWN
CHKD
APVD

DATE: 04/91

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AND
ASSOCIATES
LTD

TITLE
FIGURE 3.6
CONCEPTUAL GENERAL
ARRANGEMENT 100 TONNES/DAY CPF

DWG NO.

and smaller quantity recoverable materials and let the newspaper accumulate in the final bunker of the sorting line. The less material that is physically handled reduces labour costs and increases throughput capability of the processing line. The fibre processing line for this facility has a maximum capacity of approximately 10 tonnes per hour.

The container processing line has a design capacity of approximately 3 tonnes per hour. Commingled containers are tipped into a continuous feed floor conveyor, which is fitted with a rubber lined skirt on the receiving edge. This skirt acts as a buffer to minimize the breakage of glass. Depending on the level of contamination of the incoming materials it may be necessary to provide a pre-sort station before the overhead magnetic separation stage. This would allow for the removal of contaminants such as steel paint cans and aerosol spray cans prior to the first stage of magnetic separation.

Steel cans are the first material to be separated from the commingled stream. This is accomplished through the use of a suspended magnetic separator. This separator will remove 90-95% of the steel present in the commingled stream. The separated cans are then passed through a can flattener to decrease volume, or alternatively, can be conveyed to a concrete bunker and flattened by front-end loader.

The remaining commingled materials are passed on to a density separator which splits the materials into a light and heavy fraction. This separator could be a vibrating gravity table, an air separation system or a rotating brush type. The most economical alternative is the rotating brush. The brush is designed to allow heavy materials to pass through and the light materials are brushed into a separate path.

The heavy fraction, as it leaves the density separator, is primarily glass containers. This glass is collected on a rotating sorting conveyor for subsequent manual colour separation. The advantage of using the sorting ring is that temporary storage is gained. In terms of operations it allows sorters to be allocated more effectively since they are not required on the sorting ring until it is at capacity.

The light fraction is passed through another screen which separates according to size. The resultant materials on the divided sorting conveyor are large plastic containers on one side and aluminum and small plastics on the other. The divided conveyor allows for negative sorting of the aluminum cans and the ability to transfer any aluminum cans which pass through to the large or oversize side of the sorting belt. Manual separation is required for all of the materials except for the aluminum which is left on the sorting conveyor. The aluminum undergoes a second magnetic sort to assure product purity and to remove any remaining steel cans which were not removed by the suspended magnetic separator.

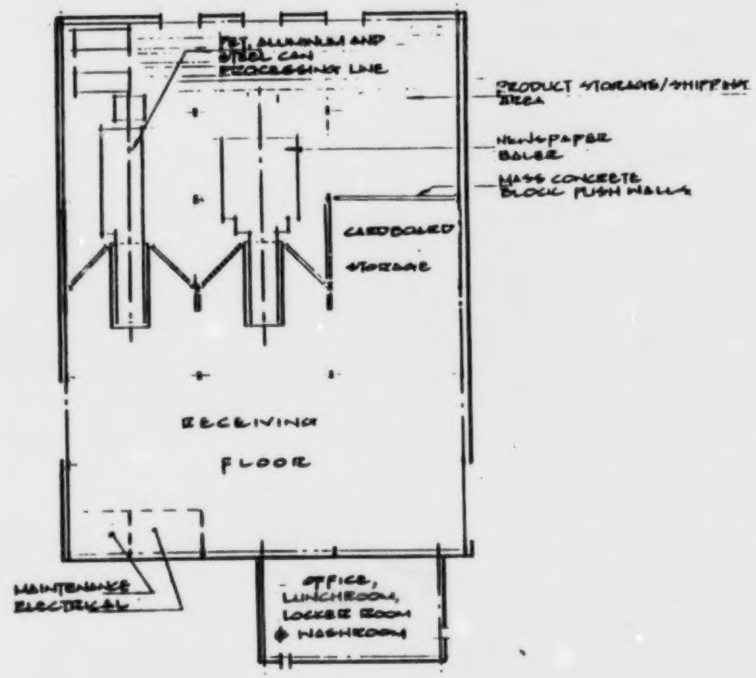
All materials except for glass containers are stored in the bunkers located beneath the picking stations on the elevated sorting platforms. When sufficient quantities of material have been accumulated the bunker is emptied by a front-end loader and the material pushed onto the baler feed conveyor. Glass containers are stored in bunkers beneath the sorting ring, or alternatively, they can be dropped directly into roll-off containers for shipping. **Figure** 3.7 illustrates a typical site plan appropriate to any of the four CPF's with variations to the scale.

3.2.2.2 Materials Bulking Facility

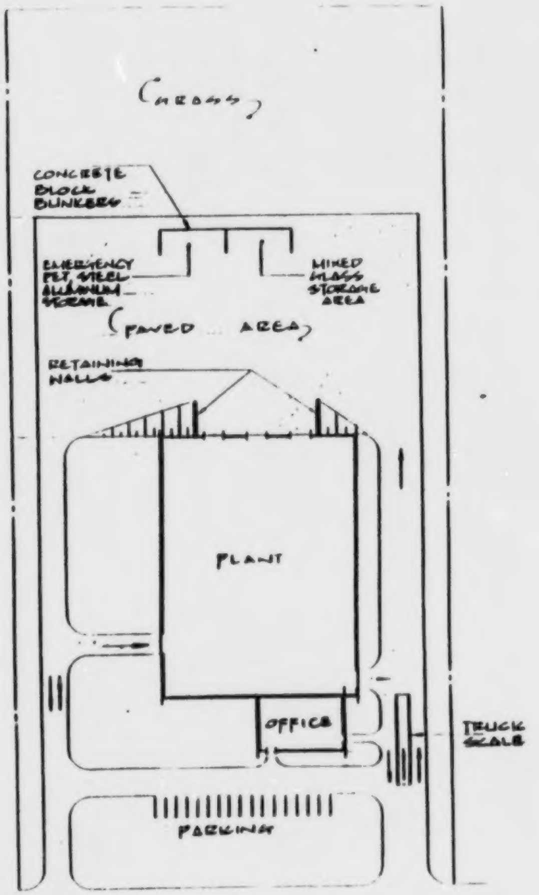
Figure 3.7 also presents the conceptual Materials Bulking Facility layout plan for serving low volume systems diverting less than 150 tonnes of recyclable materials per week for processing.

The depot materials bulking facility is designed to accept materials collected from depot sites. Materials which are source separated and collected in multi-compartment vehicles could also be accepted at this facility. The entire operation could be enclosed in a pre-engineered building 600 - 800 m^2 in size.

The incoming materials would be tipped onto the receiving floor and segregated by a front-end loader to designated areas on the floor. The facility is highly labour intensive with no automated sorting equipment. Any sorting would be accomplished manually through the use of portable sorting tables which are loaded with a bobcat. Since the plant does not incorporate a sorting conveyor for fibre materials this facility is best suited to processing clean loads of separated commercial and institutional recyclables. The facility includes a small horizontal baler to prepare paper, cardboard, plastics and aluminum and steel cans for shipment to market. Glass would be stored in roll-off containers until sufficient quantities are available for shipment.


PET ALUMINUM AND STEEL CAN PROCESSING LINE
PRODUCT STORAGE/SHIPPING AREA
NEWSPAPER BALER
MASS CONCRETE BLOCK PUSH WALLS
CARDBOARD STORAGE
RECEIVING FLOOR
MAINTENANCE
ELECTRICAL
OFFICE, LUNCHROOM, LOCKER ROOM & WASHROOM

MATERIAL BULKING FACILITY
600 - 800 m² (TYP)


(GRASS)
CONCRETE BLOCK BUNKERS
EMERGENCY PET, STEEL ALUMINUM STORAGE
MIXED GLASS STORAGE AREA
(PAVED AREA)
RETAINING WALLS
PLANT
OFFICE
TRUCK SCALE
PARKING

NOTES

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FIGURE 3.7
TYPICAL CPF SITE PLAN AND
CONCEPTUAL BULKING FACILITY

DWG NO.
REV

3.3 Maximized Recycling Facilities

The maximized recycling program will involve curbside collection of source separated "wet" and "dry" materials, representing the entire regular residential waste stream (except bulky items, such as large brush, white goods, inert fill materials, etc.) in separate low compression packer vehicles or in specially designed two compartment recycling vehicles. Household containers, "bags" or "bins", will be distributed to all households to be serviced by the program. Materials will be collected every week on a regular basis. Separate arrangements will be made to accommodate "wet/dry" materials from all other sources; such as, apartments, institutions (i.e., schools, hospitals, nursing homes, office buildings), commercial establishments (i.e., restaurants, shopping malls, supermarkets, food terminals), and industries (i.e., food processing, factories, warehouses). The industrial sector requires special attention to defining the acceptable "dry" waste stream, since it is not a function of the processing facilities to separate hazardous wastes or to process clean process wastes; for example, metal stampings. The dry materials collected will be delivered to a processing facility for separation into recycled materials (which will be transported to markets) and residue (for transfer to landfill). The "wet" materials will be composted with residues sent to landfill. The processing facilities will typically be operated five days a week, two shifts a day.

It is estimated that 55 per cent of the "dry" waste processed and at least 80 per cent of the "wet" waste processed will be recovered, resulting in an **overall recovery rate of 60 to 66 per cent of the total waste processed. Figure 3.8** illustrates typical recovery levels from dry and wet waste streams, which result from each process.

For the purposes of this study two different capacity Maximized Recycling facilities have been developed. The facilities also differ in level of technology and state-of-the-art design. The large Maximized Recycling and Composting facility is designed to accept and process up to 10 tonnes per hour of residential "dry" wastes and up to 10 tonnes per hour of institutional/commercial/industrial "dry" wastes, or 20 tonnes per day combined dry processing capacity. The composting facility has a maximum daily capacity of 150 tonnes of source separated "wet" wastes. In addition, this large facility includes a separate Household Hazardous Waste depot and a public drop off area for bulky items and separated wood, tires, construction

MaxRF IMPACT ON PROCESSABLE WASTE STREAM

PROVINCE OF NEW BRUNSWICK

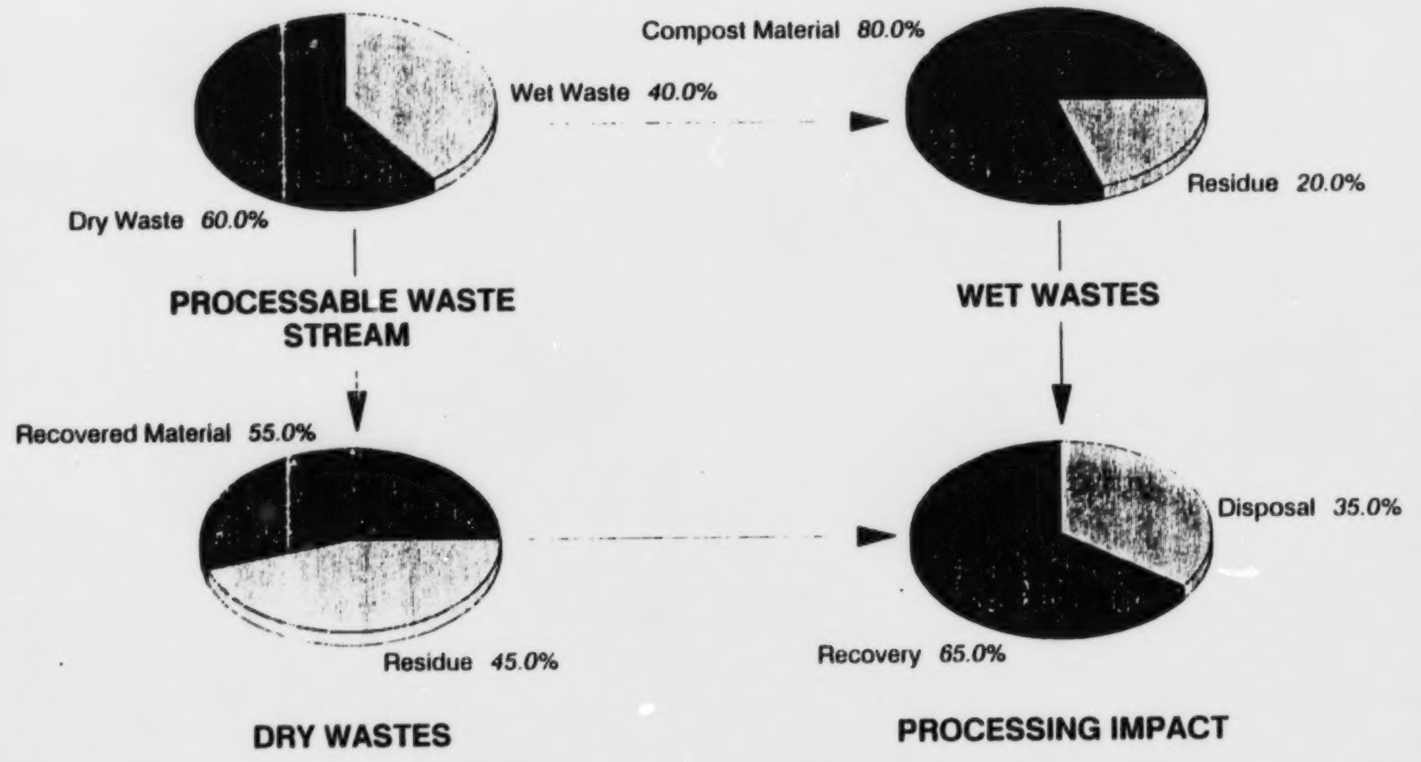


FIGURE 3.8

wastes, etc. This results in a combined wet-dry annual throughput capacity of 145,000 tonnes for a two-shift operation.

The smaller Maximized Recycling and Composting facility is designed to accept and process up to 5 tonnes per hour of residential "dry" wastes and 5 tonnes per hour of institutional/commercial/industrial "dry" wastes. The composting facility has a maximum daily capacity of 50 tonnes. This results in a combined wet-dry annual throughput capacity of 60,000 tonnes for a two-shift operation.

3.3.1 MaxRF Costs

The estimated costs of the buildings, equipment and operations of the wet and dry component facilities of each of the large and small MaxRF's are as follows in **Table 3.3**.

3.3.2 Typical MaxRF Facility Components General System Overview

3.3.2.1 MaxRF Components

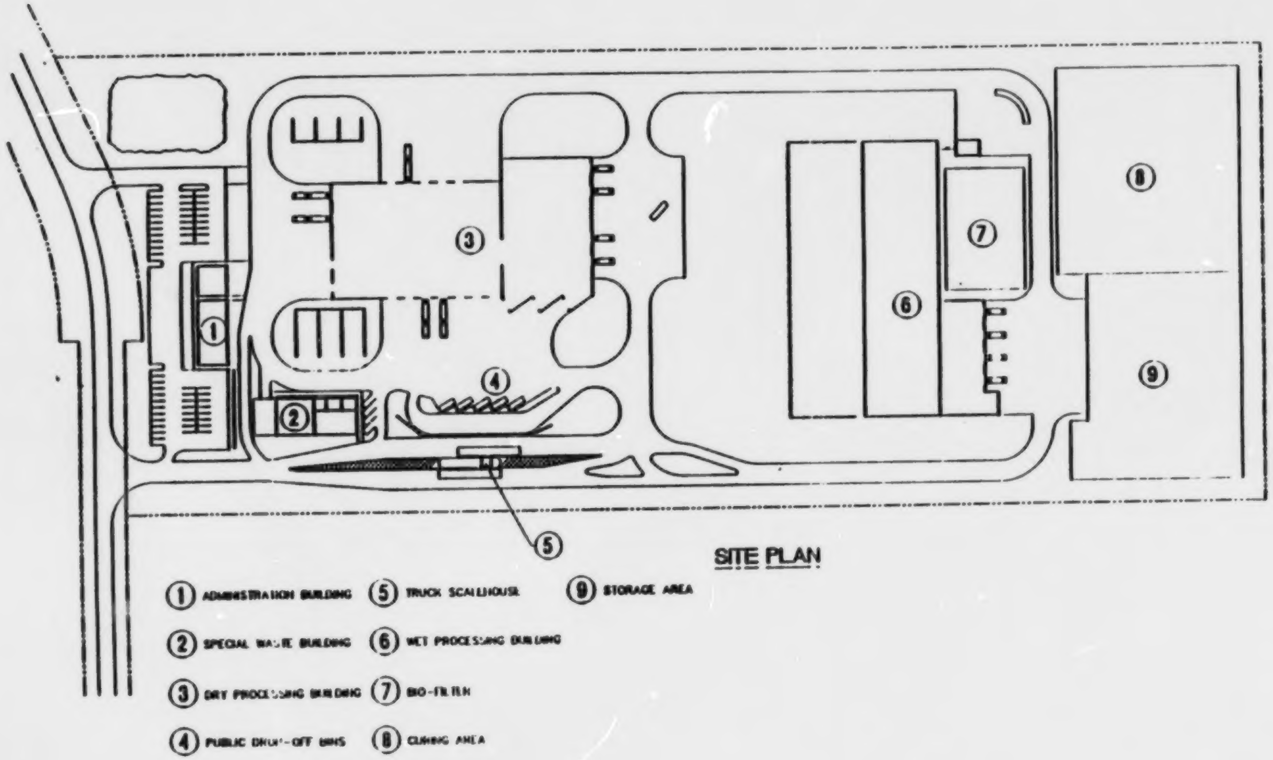
Figure 3.9 presents a typical conceptual Large MaxRF Site Plan. A small MaxRF Site Plan would retain many of the same essential components, only at smaller scale, but would exclude separate administration and household hazardous waste buildings.

Administration Building

- a two storey structure comprising an administration area, conference room, general offices, laboratory, reception area, lunch room, men's and women's wash and change rooms, lockers and showers.

Truck Scale

- a 20 metre long pit scale with electronic load cells, computerized recording/invoicing system, electronic traffic control signals and a scale house.


1
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① ADMINISTRATION BUILDING
② SPECIAL WASTE BUILDING
③ DRY PROCESSING BUILDING
④ PUBLIC DROP-OFF BINS
⑤ TRUCK SCALEHOUSE
⑥ WET PROCESSING BUILDING
⑦ BIO-FILTER
⑧ CURING AREA
⑨ STORAGE AREA

SITE PLAN

NOTES

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FIGURE 3.9
CONCEPTUAL MaxRF SITE PLAN

DWG NO

TABLE 3.3

MAXRF OPTIONS COSTS

1. LARGE MAXRF PLANT

- Dry Waste throughput up to 10 tonnes per hour of residential waste
- up to 10 tonnes per hour of ICI waste
- Composting (wet facility) daily capacity 150 tonnes

AREA DESCRIPTION	ESTIMATED COST
Administration Building	$480,000
"Dry" Materials Receiving/Processing Facility (6,000m^2)	
- Building	$3,650,000
- Equipment	$6,185,000
"Wet" Material Receiving Facility (1,000 m^2)	
- Building	$590,000
- Equipment	$1,222,000
"Wet" Material Processing Facility (5,200 m^2)	
- Building	$2,515,000
- Equipment	$1,650,000
- Biofilter System	$267,000
Weighscale and Scale House	$325,600
H.H.W. Facility (200 m^2) (Household Hazardous Waste)	$252,200
Site Works and Services	$2,103,000
Mobile Equipment	$576,000
Promotion and Advertising (1 year)	$250,000
Engineering and Construction Supervision	$3,000,000
Geotechnical and Testing Costs	$50,000
Subtotal Capital Costs	**$23,115,800**
Contingencies	$2,000,000
TOTAL CAPITAL COST	**$25,115,800**
ESTIMATED ANNUAL OPERATING COST	**$2,799,883**
AMORTIZED CAPITAL COST[1]	**$3,362,473**

---

[1] Amortized capital cost is at 12 percent interest over 15 years.

Table 3.3 (Cont'd)

2. SMALL MAXRF PLANT

DRY MATERIALS PROCESSING FACILITY

Approximate Building Size	- 3720m² (40,000 ft²) - 25% storage Capacity on Transfer Trailers
Annual Throughput Capacity	- 8,750 tonnes single shift Domestic Dry Waste - 8,750 tonnes single shift Commercial Dry Waste

AREA DESCRIPTION	ESTIMATED COST
Residential Processing Line	$515,000
Commercial Processing Line	$180,000
Baler and Feed Conveyor	$380,000
2-Bobcats/Forklift	$150,000
Recovered Material Bins	$25,000
Weighscale (inc. Foundation)	$120,000
Building Estimate	$2,200,000
Subtotal Capital Cost	**$3,579,000**

WET MATERIALS PROCESSING/COMPOSTING FACILITY

Annual Throughput Capacity -12,500 tonnes per year (50 tonnes per day)

AREA DESCRIPTION	ESTIMATED COST
Mobile Equipment	$120,000
Screen	$95,000
Reactor Cell Building/Equipment	$4,475,000
Sub total Capital Cost	**$4,690,000**
Subtotal Capital Costs (Wet and Dry)	**$8,269,000**
Contingencies	$826,900
TOTAL CAPITAL COST	**$9,095,900**
ESTIMATED ANNUAL OPERATING COST	**$876,462**
AMORTIZED CAPITAL COST[1]	**$1,217,748**

---

[1] Amortized capital cost is at 12 percent interest over 15 years.

"Dry" Material Receiving

- a 10 metre high clear span structure with drive in truck doors, divided between the "residential" and the "industrial/commercial" streams, with concrete push walls and a specially hardened concrete tipping floor.

"Dry" Material Processing

- a 7 metre high structure housing the entire "dry" processing system for both the "residential" and the "industrial/commercial" streams, including finished materials storage and shipment.

"Wet" Material Receiving

- similar in construction to the "dry" receiving building, with equipment to open plastic bags and separate the organic materials from the plastic; as well as, remove ferrous metals; provision is made for chipping and storing brush.

"Wet" Material Processing

- a fully enclosed reactor cell building, designed to provide approximately ten weeks of residence time for both kitchen organic and yard wastes, with mechanical turning, alternating aeration cycles, odour control by means of a "bio-filter" system, and outfeed screen

Curing Area

- a separately drained surface for curing and storing the screened, finished compost material prior to shipment.

Site Storage

- a set of concrete bunkers for on-site storage of specific recoverable materials; such as, "white goods", construction timber, rubber tires, scrap metal, drywall, etc.

Public Drop-off

- a public drop-off facility, in order to accommodate "wet" and "dry" materials which are not collected by the usual municipal or private collection vehicles, consisting of a ramp and several roll-off bins (which will be transferred to the appropriate receiving building, daily or when filled).

HHW Facility

- a public "Household Hazardous Waste (HHW) Facility" to receive, segregate, bulk and store household hazardous materials, prior to shipment to an authorized hazardous material disposal facility for final treatment and disposal.

Bio-filter

- a natural air filtering medium; typically, wood chips, tree bark, finished compost material, etc., which is kept continually moist.

3.3.2.2 Dry Process Description

Figure 3.10 illustrates a typical dry process flow plan applicable to both Large and Small MaxRF's.

Method of Delivery

Collection vehicles delivering source separated "dry" wastes from both residential and industrial/commercial/Institutional (ICI) sources will weigh-in on arrival at the processing facility. At the scale house, only those vehicles with a registration number will be allowed access to the site. New users of the facility will have their loads visually inspected prior to acceptance, and will have to register before access is granted. The registration data required will include a list of stops made on the particular collection route; particularly if the delivery is by an ICI collection vehicle.

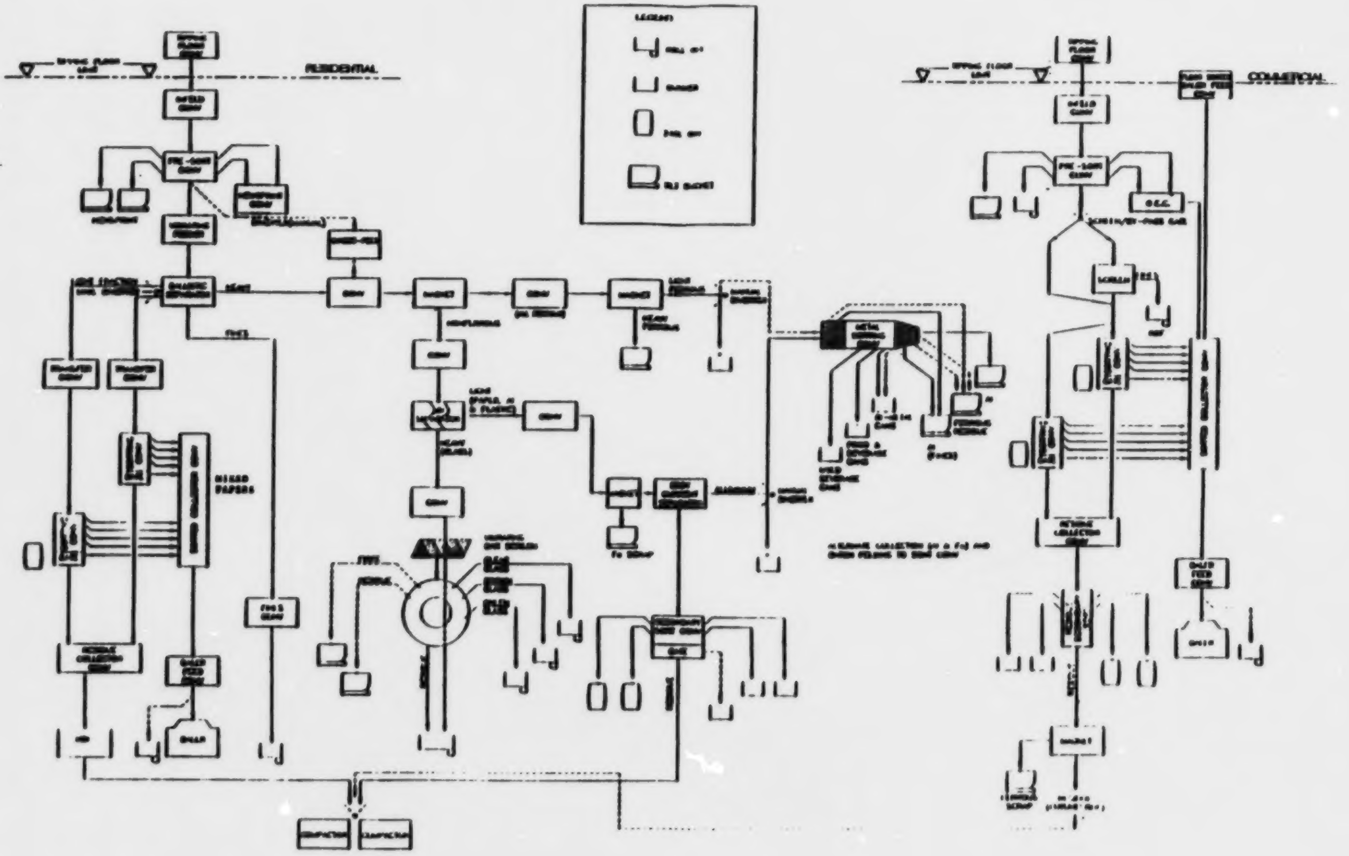
RESIDENTIAL
COMMERCIAL
MIXED PAPERS
O.C.C.

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FIGURE 3.10
TYPICAL DRY PLANT PROCESS FLOW

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"Dry" Material Receiving and Tipping Area

Upon notification from the scale house operator, the tipping floor supervisor will direct the collection vehicle to unload its contents according to the type of waste being delivered. Truck movement will be monitored and controlled by the tipping floor supervisor. In the larger "dry" processing facility the tipping floor will be physically isolated from the "dry" processing area in order to provide a clean working environment, and will be large enough to store a full day's collection of "dry" waste.

Preliminary sorting of any non-processable materials, or clean materials, which do not require processing, will be accomplished on the receiving floor by a front end loader. As the material is unloaded from the delivery vehicle, it will be inspected by the floor spotter in order to identify any problem materials, which will be removed and separated for disposal or sent to one of the site storage bunkers for recyclable items. The remaining "processable" material will be pushed onto one of the in-floor feed conveyors, according to waste type. The processing system will have two separate lines: one for the recovery of recyclables from source separated **residential** "dry" wastes, and one for the recovery of recyclable materials from source separated ICI "dry" wastes.

3.3.3 Large MaxRF Process Description

Figure 3.11 illustrates the layout of the Large MaxRF (20 tonnes per hour) dry processing plant.

3.3.3.1 Residential "Dry" Waste Processing Line

Residential "dry" wastes, which have been designated processable by the floor spotter, will be loaded onto the tipping floor conveyor, and conveyed up and into the processing area to a pre-sort station. The purpose of this pre-sort is to provide a second visual inspection for reject materials, and to remove any oversize materials which may cause problems further on in the process. Large bundles of newspaper will also be removed at this location in order to ease the burden depth on the "light" fraction sorting. This newsprint will be stored and baled with the newsprint recovered from the light fraction sorting conveyor. The sorting station will be equipped with a manual override switch, so that either of the sorters will

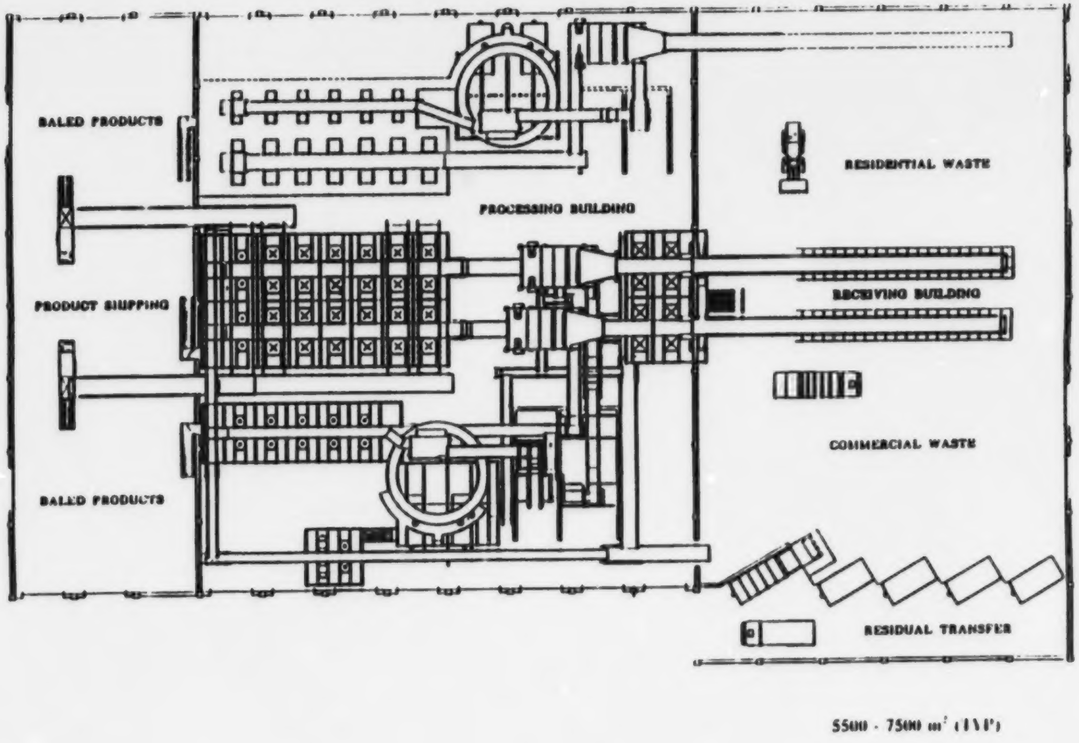
BALED PRODUCTS
PRODUCT SHIPPING
BALED PRODUCTS
PROCESSING BUILDING
RESIDENTIAL WASTE
RECEIVING BUILDING
COMMERCIAL WASTE
RESIDUAL TRANSFER
5500 - 7500 m² (TYP)

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FIGURE 3.11
20 TONNES/HOUR DRY PLANT
LARGE MaxRF

DWG NO

have the ability to shut down the feed conveyor, if required. The remainder of the material will continue, via a vibrating feeder, onto the primary stage of mechanical separation. If the material to be processed is free of fibrous materials, there will be a diverter which will allow direct feeding of these materials for processing.

The next stage of primary mechanical separation is designed to separate, with reasonable efficiency, the lighter flat materials (essentially fibre and film) from the heavier fraction (essentially containers). The goal is to separate the material to a level which makes feasible manual recovery of the various recyclable components. In order to accomplish this split, the material will be fed to a ballistic separator after the pre-sort station. This separator will split the "dry" feed material into "light", "heavy", and "fine" fractions.

The "light" fraction from the ballistic separator will be conveyed into the enclosed, climate controlled sorting room. The material will be conveyed uniformly past a series of picking stations, where the various components: newsprint, fine papers, plastic film, cardboard, and mixed papers, will be manually picked off of the belts and dropped through chutes adjacent to the conveyor, into storage bunkers located below the platform. Non-recyclable materials will be left on the belt to discharge off the end onto the residual collector conveyor and transferred to a compactor. When sufficient quantities of materials have accumulated in the storage bunkers beneath the sorting platform, they will be transferred to the sorted material collection conveyor and baled for shipment to market.

The "heavy" fraction from the ballistic separator will be subjected to a series of additional mechanical process steps in order to further segregate the "heavy" materials into suitable categories for manual sorting. From the ballistic separator, the "heavy" fraction will be conveyed past the primary electromagnetic separator, which will split the "heavy" materials into a ferrous and a non-ferrous fraction. The ferrous fraction will be further separated according to weight by passing the material under a second, less powerful, electromagnet. The "heavy" ferrous material, will be discharged off the conveyor and collected in a wheeled container. This "heavy" ferrous metal will consist of scrap-grade materials only, and will be virtually free of steel food and beverage containers. The "light" ferrous fraction will be stored temporarily in an elevated storage hopper and periodically batch fed to an enclosed manual sorting conveyor for the separation of contaminants from marketable food and beverage cans. The recovered steel cans will be baled, or flattened and shipped loose, depending on market requirements. The metal sorting conveyor will also be used to "high grade" aluminum, on a more or less continuous basis, except when batch feeding ferrous material. Two sorting personnel per shift will be required at this location during normal operation.

The non-ferrous "heavy" fraction, will be conveyed to an air classifier in order to separate the "heavy" components; such as, glass, from the "lighter" components, such as aluminum cans and plastic containers. The "heavy" material discharging from the air classifier, will be screened in order to remove small broken pieces of glass, and then directed to a rotating ring conveyor for manual sorting. There will be four enclosed sorting stations on the ring, for the manual recovery of glass into "clear and "coloured" fractions, and "heavy" fibre, such as telephone books. The recovered materials will be thrown forward, off of the ring, and down through chutes into roll-off containers. When the ring conveyor has been cleared of recoverable materials, the residual will be discharged into a roll-off container, by opening a side panel on the conveyor.

The "light" material which has been separated by the air classifier, will be subject to a final ferrous check before passing by an eddy-current separator for the removal of aluminum. The separated aluminum, will be diverted to the metal sorting conveyor in order to "high grade" the material into UBC (Used Beverage Can) and scrap aluminum grades. The remaining non-aluminum light fraction will consist primarily of container plastic; such as, PET and HDPE bottles. These materials will be conveyed to a secondary sort conveyor where four sorters per shift will recover PET bottles, HDPE Bottles, mixed rigid plastics and Polystyrene. Residual materials; such as, multi-laminates, will be collected on the residue conveyor and diverted to the compactor. The recovered materials will be stored in bunkers beneath the sorting station, until a sufficient volume is available for baling.

3.3.3.2 ICI "Dry" Waste Processing Line

ICI "dry" wastes will be processed in a similar fashion to the residential "dry" wastes, except that the primary mechanical separation will be accomplished using an oscillating screen. The "high volume" recoverable materials from the commercial wastes will be primarily: cardboard, paper and plastic film. For this reason, it will not be cost effective to include extensive processing equipment in order to handle the so-called "blue box" materials within this waste stream. Typically, fibre and film materials represent 68 to 75 per cent of the volume of ICI "dry" waste. It is suggested that commingled materials be collected in bags when included with the ICI "dry" waste. This method of commingled collection from the ICI generators will allow separation of the container fraction on the tipping floor. This separated commingled material will be set aside and batch fed into the residential "dry" processing system, which has the necessary equipment to separate and receive the commingled materials.

The inspected ICI "dry" wastes from the tipping floor will be conveyed up to a pre-sort conveyor for visual inspection of the materials and removal of wood, reject materials and bagged commingled recyclables missed from the floor sort. The remaining material will be passed over a screen in order to remove the "fine" fraction, which will clean up the material for subsequent manual sorting. The screened material, will be conveyed to an enclosed sorting room, similar to the residential "dry" process line, "light" fraction sorting room. This elevated sorting platform will house two conveyors in order to facilitate the manual recovery of the following items: cardboard, plastic film, mixed fine paper, mixed paper, and boxboard. The recovered materials will be dropped down through chutes into storage bunkers located beneath the platform until enough material is available for baling.

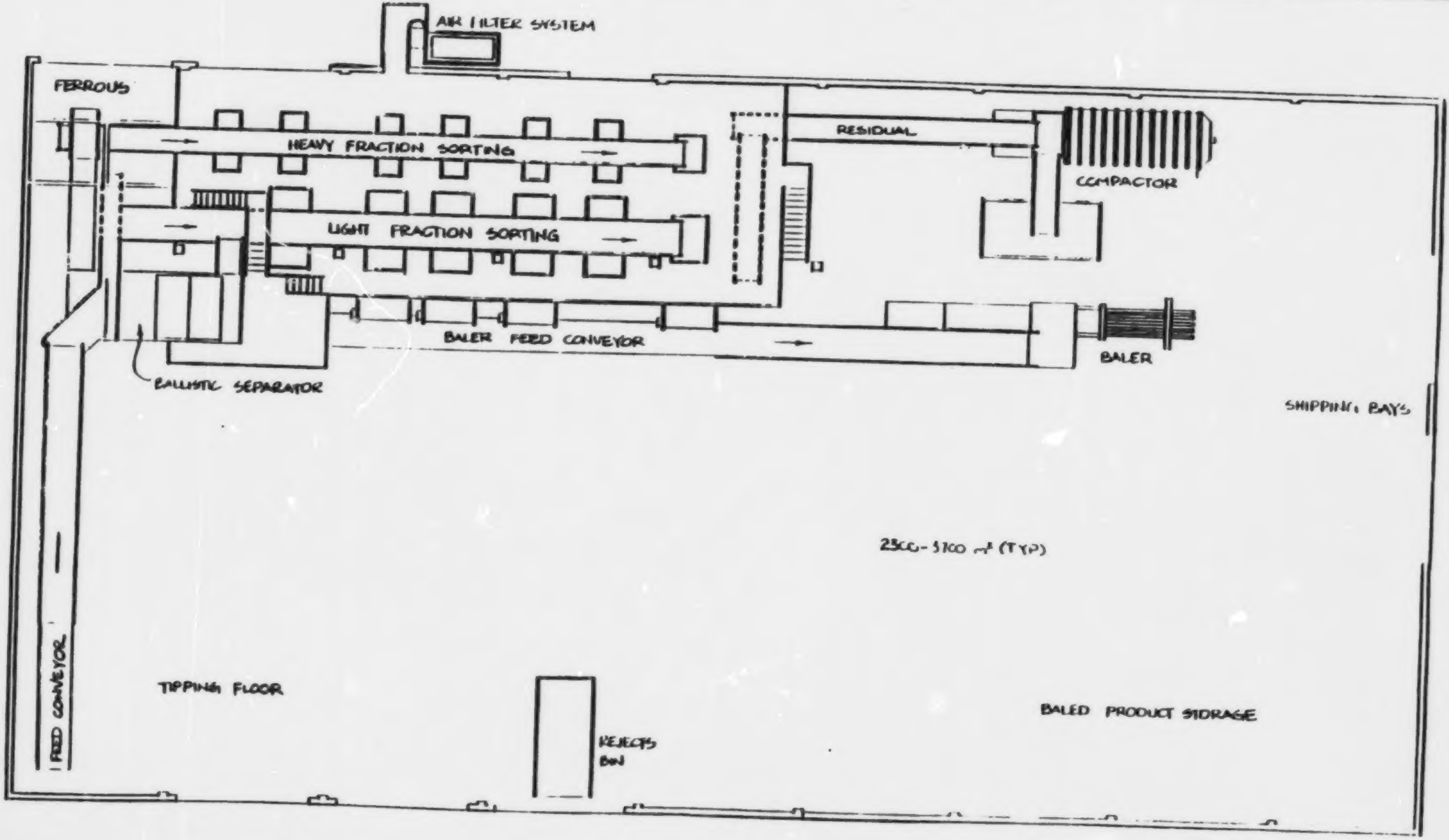
The remaining "dry" material will be conveyed to a secondary sorting conveyor which will be located in the same sorting room as the secondary sort from the residential "dry" process line. Two to four sorters per shift will recover plastic containers and recyclable polystyrene from the ICI "dry" waste. The remainder of the material will be passed under an electromagnet in order to recover ferrous scrap. The remaining material will then be conveyed to the compactor as residual.

3.3.4 Small MaxRF Dry Process Description

Figure 3.12 illustrates the layout of the Small MaxRF (10 tonnes per hour)dry processing plant.

3.3.4.1 Residential "Dry" Waste Processing Line

Residential "dry" wastes, which have been floor inspected for potentially hazardous materials, are loaded onto the tipping floor conveyor, and conveyed up and into


AIR FILTER SYSTEM
FERROUS
HEAVY FRACTION SORTING
RESIDUAL
COMPACTOR
LIGHT FRACTION SORTING
BALER FEED CONVEYOR
BALER
BALLISTIC SEPARATOR
SHIPPING BAYS
2300-3700 m² (TYP)
FEED CONVEYOR
TIPPING FLOOR
REJECTS BIN
BALED PRODUCT STORAGE

NOTES

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FIGURE 3.12
10 TONNES/HOUR DRY PLANT
SMALL MaxRF

DWG NO

collection from the ICI generators will allow separation of the container fraction on the tipping floor. This separated commingled material will be set aside and batch fed with the residential "dry" wastes.

The inspected ICI "dry" wastes from the tipping floor will be conveyed up to a oscillating screen in order to remove the "fine" fraction, which will clean up the material for subsequent manual sorting. The screened material will be conveyed to the elevated sorting platform in order to facilitate the manual recovery of the following items: cardboard, plastic film, mixed fine paper, mixed paper, and boxboard. The recovered materials will be dropped down through chutes into storage bunkers located beneath the platform, until enough material is available for baling.

The remainder of the material will be passed under an electromagnet in order to recover ferrous scrap. The remaining material will then be conveyed to the compactor as residual.

3.3.5 MaxRF "Wet" Process Description - Small and Large Composting Facilities

Both the Large and Small MaxRF's have similar wet composting plant process. Figure 3.13 illustrates a typical wet plant process flow. Figure 3.14 and 3.15 illustrate the layout of the wet materials receiving area and compost reactor cells, respectively, of the 150 tonne per day Large MaxRF. Similarly Figure 3.16 illustrates the layout of the 50 tonne per day Small MaxRF wet plant. Following is the description of the wet processing plant composting operations applicable to both Large and Small MaxRF's.

Material Collected

Source separated "wet" organic materials will be collected from residential and ICI generators. Source separated organic will include: food wastes, soiled diapers, vacuum catchings, pet droppings, yard and garden wastes (including grass, leaf clippings and wood cuttings).

Also included in the "wet" material will be contaminants; such as, plastic film, paper, metal foils, container lids, metal cans, foam packaging, etc. The amount of

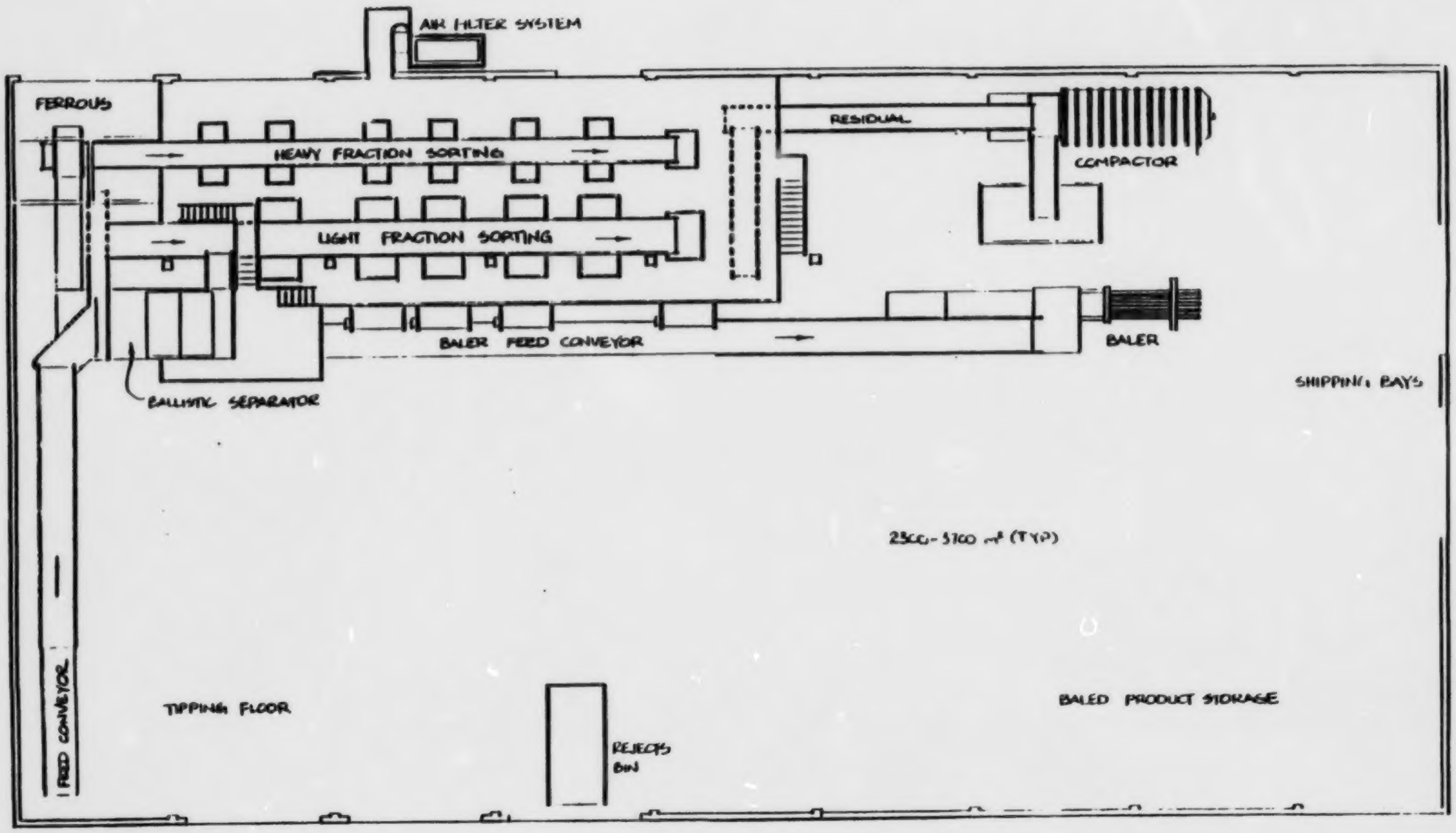
AIR FILTER SYSTEM
FERROUS
HEAVY FRACTION SORTING
LIGHT FRACTION SORTING
RESIDUAL
COMPACTOR
BALER FEED CONVEYOR
BALER
BALLISTIC SEPARATOR
SHIPPING BAYS
2300-3700 m² (TYP)
FEED CONVEYOR
TIPPING FLOOR
REJECTS BIN
BALED PRODUCT STORAGE

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FIGURE 3.12
10 TONNES/HOUR DRY PLANT
SMALL MaxRF

DWG NO

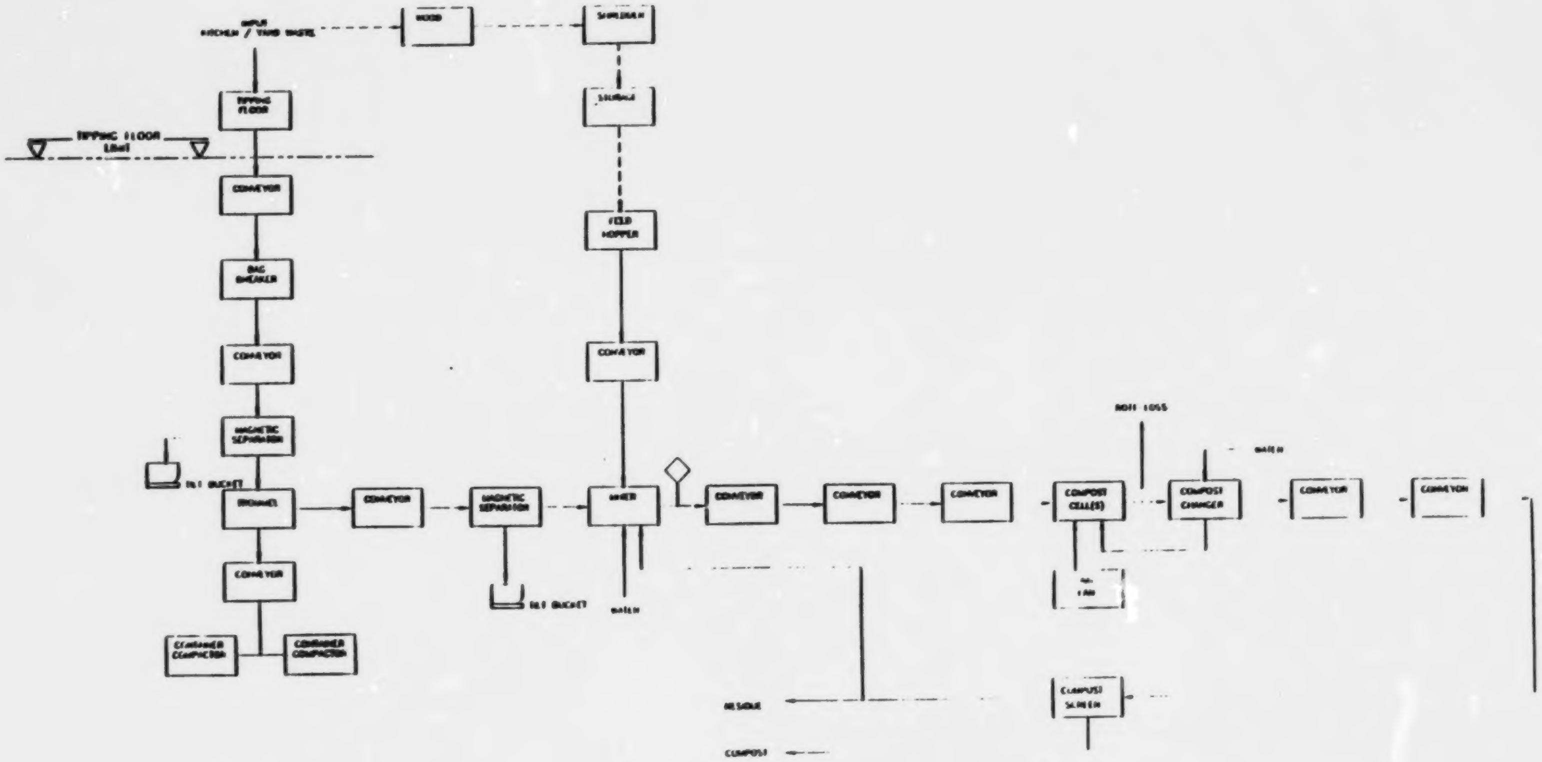
INPUT
KITCHEN / YARD WASTE
WOOD
SHREDDER
STORAGE
FEED HOPPER
CONVEYOR
TIPPING FLOOR
TIPPING FLOOR LIMIT
CONVEYOR
BAG BREAKER
CONVEYOR
MAGNETIC SEPARATION
FE BUCKET
TROMMEL
CONVEYOR
MAGNETIC SEPARATION
FE BUCKET
MIXER
WATER
CONVEYOR
CONTAINER COMPACTOR
CONTAINER COMPACTOR
CONVEYOR
CONVEYOR
CONVEYOR
COMPOST CELL(S)
MOIST LOSS
FAN
COMPOST CHANGER
WATER
CONVEYOR
CONVEYOR
COMPOST SCREEN
RESIDUE
COMPOST

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FIGURE 3.13
TYPICAL WET PLANT
PROCESS FLOW

DWG NO
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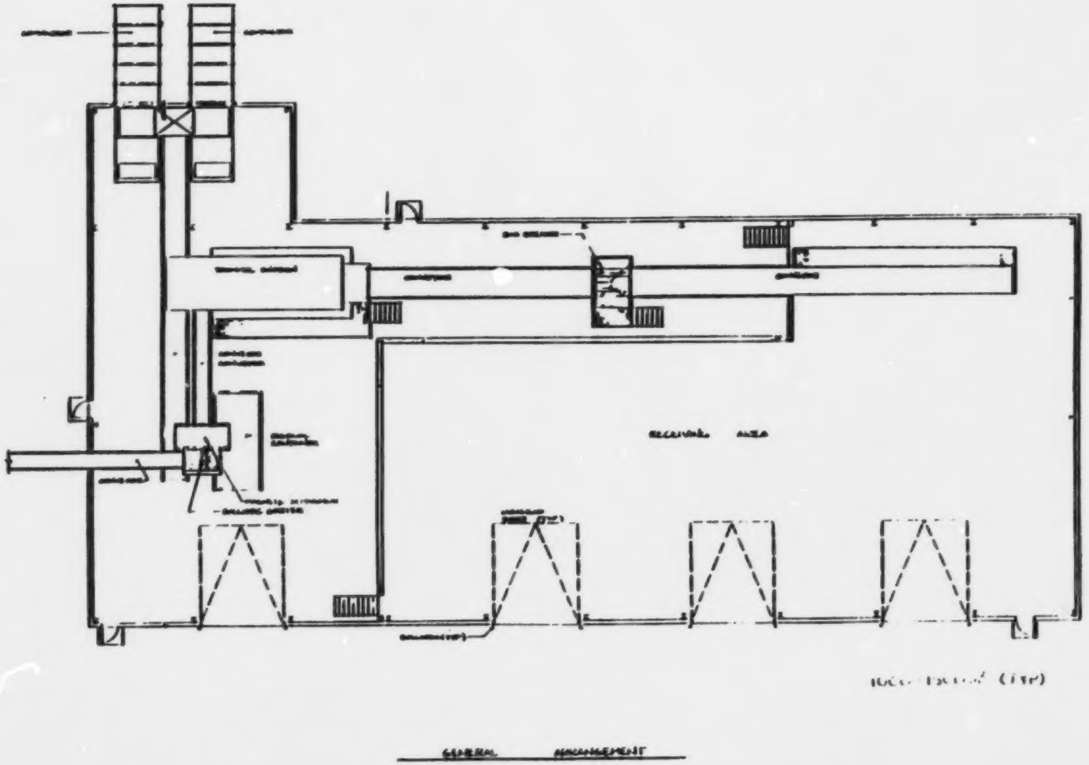
RECEIVING AREA
GENERAL ARRANGEMENT

NOTES

SCALE: NTS
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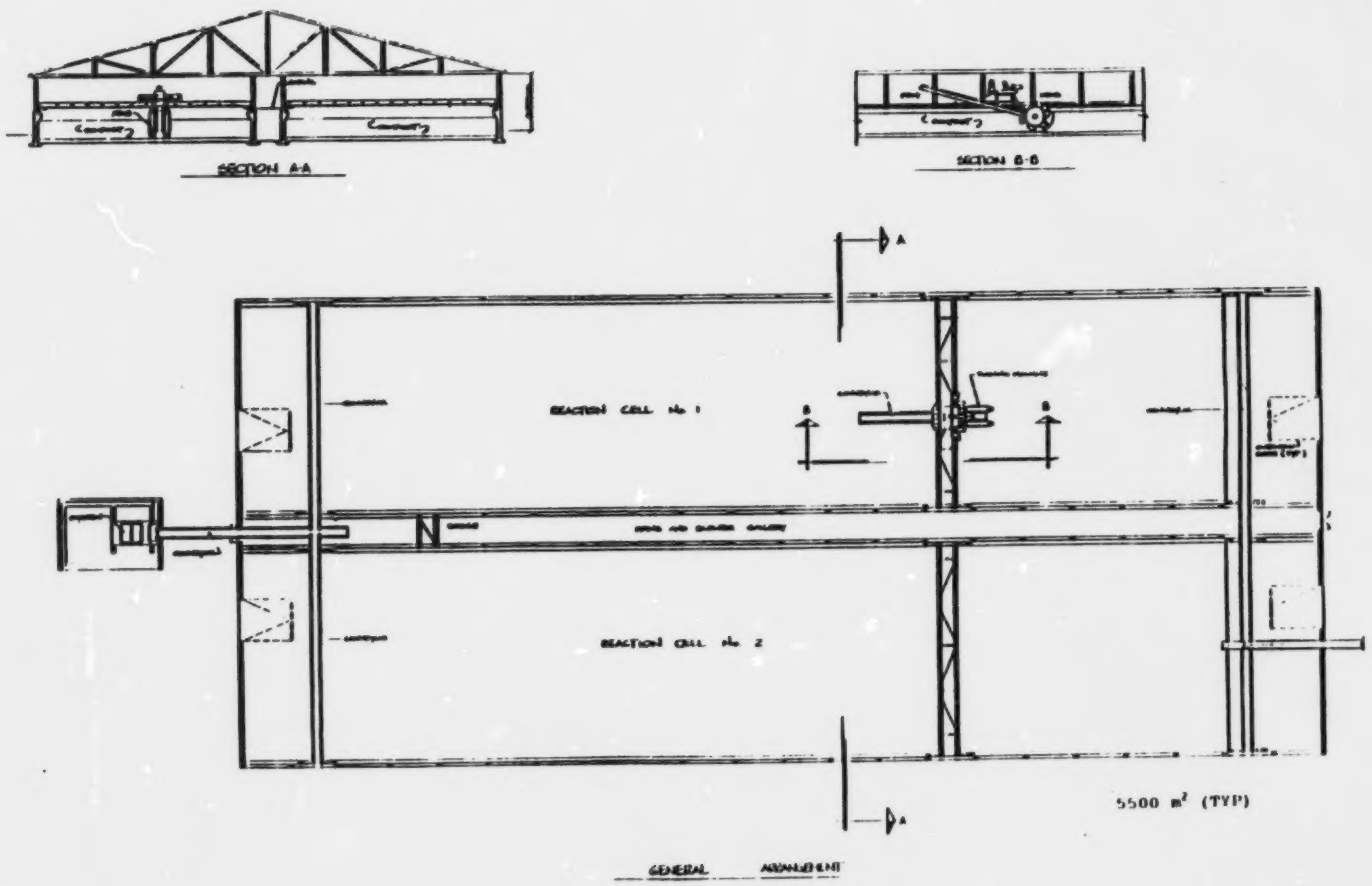
FIGURE 3.14
LARGE MaxRF
WET RECEIVING AREA

DWG NO


SECTION A-A
SECTION B-B
A
A
B
B
REACTION CELL No. 1
REACTION CELL No. 2
5500 m² (TYP)
GENERAL ARRANGEMENT

NOTES

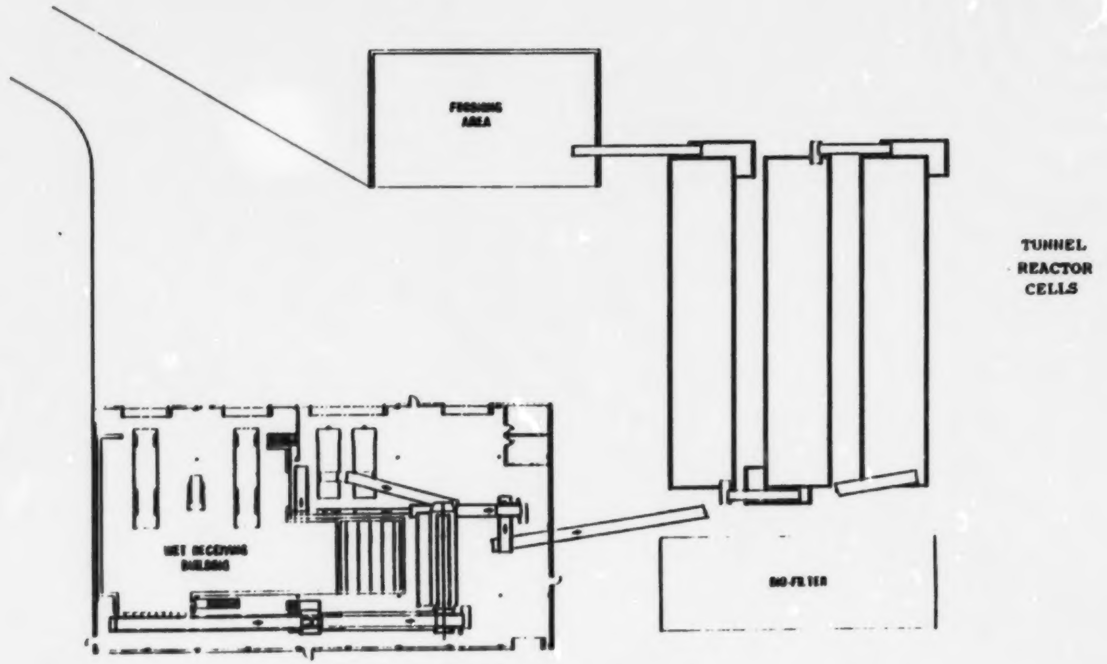
SCALE: NTS
DES
DRWN
CHKD
APPD

DATE: 04/91

R. CAVE
AND
ASSOCIATES
LTD
CONSULTING ENGINEERS

TITLE
FIGURE 3.15
LARGE MaxRF
COMPOST REACTION BUILDING

DWG NO.



FINISHING AREA
TUNNEL REACTOR CELLS
WET RECEIVING BUILDING
BIO-FILTER

NOTES

SCALE: NTS
DES
DRWN
CHKD
APPD

DATE: 04/91

R. CAVE
AND
ASSOCIATES
LTD.
CONSULTING ENGINEERS

TITLE

FIGURE 3.16
SMALL MaxRF WET PLANT
50 TONNES/DAY

DWG NO

contaminant material is not expected to exceed 15 to 20 per cent of the total "wet" waste stream.

Front End Processing

Excess wood wastes, which will be received during the months from April through November, will be removed from the "wet" material stream and stored for later use. The remaining "wet" material will pass through a bag opening device and then be screened in order to remove the bulk of the contaminants, including plastic bags. The material will then be blended with wood, which has been chipped or shredded to minus 100 mm and water will be added in order to raise the moisture content to 65 per cent. Two ferro-magnets will remove any ferrous material from the remaining compostable material. The resulting material will be conveyed to the reactor cell building for composting over a 10 week period.

The processed "wet" material will be well mixed with wood in order to produce a friable mixture which is also nutritionally balanced and at the optimum moisture content. The "wet" material will also be relatively free of contaminants; such as, metal particles and foils, plastic films, and foam packaging.

Processing

The "wet" material will be conveyed from the front end processing area and automatically placed into the compost processing (reactor cell) building, by means of a self-unloading discharge conveyor. The floor of the compost processing building section will be fitted with a combination drainage/aeration system. The "front" and "back" end floor sections will allow for charging and discharging the compost material.

A turning machine will travel along the length of the reactor cell building, in one or more channels, in order to mix the "wet" material and to progressively move the material towards the discharge end. Water will be added to the "wet" material as it is turned. Normally, the material will be turned at least once every seven days. The turning machine will also discharge the finished "wet" material from the channel(s) onto the exit conveyor. Composted material will be removed from the reactor cell building for final curing.

An aeration system will be incorporated with the reactor cell flooring system in order to provide oxygen and to remove heat from the composting process. Air will be drawn through the compost by alternating pressure and vacuum ventilation, using the building air volume as the aeration reservoir. Fresh make-up air will be drawn from the environment, while the exhaust will be vented through a bio-filter arrangement in order to remove malodorous compounds.

Post Reactor Processing

The composted material will be removed from the reactor cell(s) and screened in order to remove any oversize material (e.g., wood bulking materials). The "unders" from the screening (i.e., compost) will be "windrowed" for further curing, while the "overs" (nominally less than 10 per cent of the composted material) will be recirculated into the compost reactors.

Emissions Control - Tipping Area

Odours will be generated in the tipping and front end processing area when the raw "wet" material is tipped on the floor, and during pre-processing as the bags are opened and the "wet" material passes through the various unit operations.

Air for the reactor cell building will be drawn from the front end processing area, resulting in a net "negative" pressure within the tipping area. Therefore, malodorous air associated with tipping operations will be drawn into the reactor cell building for use as process make-up and ultimately treated.

The residue from front end processing will be placed into compactor bins which will be emptied daily, thus reducing the odour potential from these materials.

Emissions Control - Reactor Cell Building

The principle source of malodours in the reactor cell building will be the "wet" material which is less than three weeks old. In order to reduce the odour potential of this material, air from the front end portion of the composting process will be vacuum ventilated through the nearly finished composting material, which will act as a natural bio-filter. As well, all of the air exhausted from the reactor cell building will be processed through a separate bio-filter situated beside the "wet" processing facility.

Free water from the composting process will be collected and re-introduced to the "wet" material along with any fresh make-up water which is required to maintain the moisture content of the composting material. In the event of severe process upsets or mechanical problems, where a net excess of water is produced, the excess water will require pumping to temporary storage or disposal off site at the nearest sewage treatment plant.

4.0 RECYCLING COLLECTION SYSTEMS

4.0 RECYCLING COLLECTION SYSTEMS

A very important component of the cost and performance of recycling systems is the approach taken to collecting recyclable materials. The level and types of collection service approaches taken will impact on the rate of participation in recycling and levels of material contamination, and accordingly on the rate of diversion of recyclable materials from the waste stream.

The types of recycling collection system approaches available were reviewed in Chapter 2.0 of the report. This chapter presents the range of typical vehicle and equipment options associated with the each residential and ICI recycling collection systems. It also provides the typical vehicle capital and unit operating costs, as well as their operational characteristics and performance. Recycling collection systems and vehicles are discussed in the general context of those appropriate to residential and ICI recycling.

4.1 Residential Recycling Collection Options

There are two fundamental approaches to residential recycling collection:

1. Roadside Collection Recycling Systems; and

2. Drop-off Depot Recycling Systems.

In general roadside collection recycling systems have achieved much higher program participation due to the greater ease and reduced involvement required of the resident population. Drop-off depots offer a much reduced service and require considerably more involvement of the resident population, and typically result in much lower and inconsistent levels of program participation. Roadside collection systems have also been far less subject to recyclable material contamination than drop-off depots, although contamination problems are considerably reduced if depots are supervised. Diversion rates of roadside collection recycling programs have typically been five or more times as high as drop-off depot recycling programs.

4.1.1 Residential Recycling Vehicle Options

As previously presented in **Chapter** 2.0, there are three basic roadside collection recycling systems based on the type of household container utilized for in-home storage and separation from other non-recyclable wastes. They are:

1. Blue Box System;
2. Stackable Bins System; and
3. Blue Bag System.

The choice of household recyclables container will depend upon its compatibility with the vehicles chosen for roadside collection and the degree of recyclable materials separation at source. Blue box and blue bag containers are normally used for co-mingled recyclables, while stackable bins, or other multiple bins, are used where source separation is required in the home. The choice of co-mingling recyclables in blue boxes in the home requires materials separation at the curbside by collection vehicle operations. Stackable bins are used where vehicle operators dump the in-home separated recyclables in separate vehicle compartments or storage bins. Blue bags are normally used where separation of recyclable materials take place at the processing plant. However, colour-coded bags can be used to separate in home some or all of the recyclables. Partial co-mingling of recyclables may also be required with separation of newspapers from other co-mingled plastic and aluminum containers and/or glass containers.

Typically, blue box and stackable containers are provided to residents and are clearly identified by recycling system logos, etc. Blue bags may be supplied to residents, but are often left to the residents to purchase on their own. Blue boxes generally cost from $6 to $9 apiece, stackable bins from $16 to $24 for a set of three, and blue bags for $0.08 to $0.12 per bag. Two 40 to 60 gallon wheeled carts, used primarily for wet-dry systems, cost from $20 to $25 apiece. Most of the blue box, stackable bin and wheeled cost containers will last at least 5 to 8 years, while blue and colour-coded bags are purchased on an on-going basis, as required.

The range of vehicles used for recyclables collection vary in size and configuration, but normally fall into the following categories:

1. cube vans;
2. specially - designed recycling vehicles (SDRV's);
3. packers; and
4. compartmentalized trailers.

1. Cube Vans

Early recycling programs, which focused only on recycling newspapers most commonly used cube vans. The typical cube van used for recycling consists of a three ton single rear axel truck chassis with an enclosed fibreglass box and rear roll-up door and is about 14 to 16 feet in length. Volume capacity of cube vans range from 22 to 30 cubic yards and can carry loads of from 1.5 to 2.5 tonnes (T) of recyclables, depending upon the mix of materials collected. Typically newspapers are piled to the front of the box and other recyclables are deposited in bins secured to the side walls.

Two or three person crews are required for collection operations. Cube vans can be used in any of the three roadside collection systems. Capital costs, before taxes and shipping charges, of cube vans range from $28 to $35 thousand with a four to five year service life. Vehicle operations, including amortized capital and a two-person crew, have been estimated to cost an average of $54.29 per hour.

Cube vans have the following advantages:

- Low capital and maintenance costs;
- Readily available by short-term lease to temporarily meet peak material recovery periods;
- Vehicles are maneuverable; and
- Flexible to varying mixes of recyclable materials.

The disadvantages of cube vans are:

- Two or more crews required, therefore high labour costs;
- Lengthy loading times per stop;

- Lengthy manual unloading time at processing facility;
- Low capacity due to internal space required to permit loaders to maneuver sorting and dumping materials into bins;
- Cab entry and exit is difficult; and
- Exhaust fumes can be noxious to loaders.

2. Specially Designed Recycling Vehicles (SDRV's)

SDRV's are of two basic types:

1. SDRV (ML) - manually loaded SDRV; and
2. SDRV (PL) - power loaded SDRV.

The SDRV (ML), the manually loaded specially designed recycling vehicle, and the SDRV (PL), power loaded specially designed recycling vehicle are collection trucks which consist of a compartmentalized enclosed box mounted on a one-person dual drive side loading packer chassis. The compartments are flexible to vary with material volumes and have hinged dividers to allow rear end individual dumping of each material. The dual drive cabs permit the operator to stand on the right side while driving along the collection route and to sit down on the left side while driving to and from the central processing facility and collection route.

The SDRV (ML) has openings on the side of the box, in which the operator throws each recyclable material. As the compartments fill up, side panels are used to progressively enclose the materials and allow for continued filling. The height at which recyclable materials must be lifted for dumping thereby increases as the SDRV (ML) compartments fill up. This increases the loading time per stop as the vehicle fills up. The SDRV (ML) cannot be filled to its volume capacity.

The SDRV (PL) differs only in that the box includes open-top side buckets of equivalent length as the interior material storage compartments, which are located along the bottom right-side of the box. These side buckets are hydraulicly dumped into the top of the box when filled, with the recyclable materials dropping into their respective compartments. This permits much easier loading by the operator resulting in faster loading times per stop. It also allows the SDRV (PL) to be filled to its entire volume capacity.

Both SDRV (ML) and SDRV (PL) vehicles are operated by one person only. They provide in-vehicle material separation, and are therefore are suitable to blue box, stackable bin and wheeled cart container wet-dry systems, but not blue bag. Volume capacities of SDRV's are typically 29 to 34 cubic yards, but the SDRV (ML) can only utilize 75 to 90% of the available capacity. Depending upon the mix of materials being recycled these vehicles will carry an average of 2.5 to 3.0 T in the SDRV (ML) and 3.0 to 4.0 T in the SDRV (PL).

Capital costs, before taxes and shipping charges, of SDRV's range form $73 to $80 thousand for the SDRV (ML) and from $89 to $95 thousand for the SDRV (PL). As the packer chassis of SDRV's are designed for frequent stops and heavier waste loads than typically achieved in recycling systems, their service life can be extended beyond four or five years. Vehicle operations, including amortized capital and one operator, have been estimated to cost an average of $47.70 per hour for SDRV (ML) and $49.90 per hour for SDRV (PL).

SDRV's have the following advantages:

- one-person operation reduces labour costs;
- dual drive with stand-up right hand side operation during collection;
- easy entry and exit;
- shorter loading time;
- very short unloading time for dumping separated materials;
- higher capacity, particularly SDRV (PL);
- compartment flexibility to handle changing materials mix; and
- easy loading of SDRV (PL) into low height hydraulic side buckets.

The disadvantages of SDRV's are:

- high capital cost;
- maximum volume not achieved by SDRV (ML);
- high loading height as SDRV (ML) fills up; and
- volume of loads can be restricted by first filled recyclables material compartment.

3. Packers

Packers are waste compaction vehicles normally used in roadside collection of residential garbage. They can be utilized for blue bag recyclables collection by adjusting down the compression of the hydraulic compaction system to about 600 p.s.i. or less to avoid breakage of recyclable materials. As such the compactor acts more as a push-arm to press bags together for efficient storage than as a material compactor. They are not suited to blue box or stackable bins or wheeled container systems.

Packers can be used to pick up both recyclables and garbage together; but experience has shown this approach to have considerable problems with high levels of contamination of recyclable materials and can discourage residents from recycling due to the lack of a clear distinction of the recycling system from garbage collection. Residents tend to perceive it all goes as garbage, if not highly promoted and identified as a joint recycling and garbage collection system. For these reasons packers are normally painted blue or green (or some colour or signage) to clearly distinguish it from a garbage packer, and used exclusively to collect blue bagged recyclables.

Packers can be used for wet-dry coloured bag systems, where wet and dry bags can be loaded together or individually in separate wet and dry bag collection runs. Separating wet and dry bags into different collection runs avoids the contamination and public perception problems.

There are two types of packers for residential recycling:

1. Packer (SL) - side load packer; and
2. Packer (RL) - rear load packer.

The side load packer is a one-person operated dual-drive compaction truck, with stand-up right side operation during collection. It has an enclosed steel box and a side load chamber located behind the cab, which when filled is pushed into a full enclosed storage chamber of the box. The bagged recyclable materials are hydraulicly unloaded from the rear.

The rear load packer is a two or three person crew operated single drive compaction truck. The driver normally remains in the truck cab, while one or two collectors load the bags. Loading is from the rear where a chamber is filled and pushed ahead into the storage chamber of the enclosed steel box. The bagged recyclables are hydraulicly unloaded from the rear.

Packers typically range in volume capacity from 20 to 30 cubic yards for side load and 30 to 40 cubic yards for rear load. For recyclable materials, loads range from 2.5 to 4.5 tonnes, depending upon the mix of materials collected, with the larger loads carried in the rear load packers.

Capital costs before taxes and shipping charges of packers range from $90 to $100 thousand for a packer (SL) and from $105 to $115 thousand for a packer (RL). Their service lives normally are about five years. Vehicle operations, including amortized capital and one operator for a packer (SL), and two operators for a packer (RL), have been estimated for the two type of packers to cost an average of $50.37 per hour and $62.55 per hour, respectively.

The advantages of packers are:

- are often available for conversion to recycling from existing garbage collection vehicle fleets;
- can integrate blue bag recycling collection with garbage collection;
- easy to load and unload;
- low loading heights; and
- can carry larger loads, particularly in a packer (RL).

The disadvantages of packers are:

- high capital costs;
- two or three person crew required for a packer (RL), increasing labour costs;
- not appropriate for in-home or vehicle separation of recyclable materials, thus require more material separation at central processing facilities;
- some contamination and breakage from compaction;

- considerable contamination of recyclable materials, if collected with garbage; and
- can be a disincentive to residents participation in recycling, if collected with garbage.

4. Compartmentalized Trailers

Residential roadside recycling collection systems using compartmentalized trailers are of two types:

1. Half ton with trailer; and
2. Packer (SL) with trailer.

The compartmentalized tandem axel trailers are open-top for loading with a hydraulic dump for unloading. They have adjustable compartments to suit recyclable materials composition and are appropriate for blue box, stackable bins and wheeled container cart systems. Other open trailers with sorting bins or cages have been used, but with less efficiency, particularly in unloading. The trailer is covered by a tarp while going to and from collection routes and during rainy or snowy weather. This can add significantly to collection time required. Both half tons and side load packers with trailers are difficult to maneuver and offer slower collection rates. They are normally operated by a two or three person crew, which will reduce the collection time per stop.

In a half ton with trailer recycling system, the truck is normally equipped with heavy duty drive train and suspension with an air compressor for the trailer brakes, and hydraulic system and a "goose neck" coupler to hitch the semi-trailer. The half ton itself is not utilized much for carrying recyclable materials, but acts primarily as a tractor for the semi-trailer configuration.

In a trailer hauled by a side load packer system both garbage and recyclables are collected, garbage in the packer and recyclables in the compartmentalized trailer. The driver of the right hand drive packer can pick up the garbage, while the other loader sorts the recyclables into the compartments. Alternatively, at stops where only garbage is left, the loader would deposit the garbage into the packer. The collection rate per stop is very slow with this operation due to the distance between the packer loading chamber and the rear end compartment of the trailer.

Unloading times at the recycling central processing facility and garbage disposal sites is very lengthy, especially if the disposal site is at a different location. In addition the trailer must be decoupled to dump the garbage from the packer. Another restriction of this system is that the recycling trailer may often become filled prior to the packer's capacity, particularly where bulky beverage and other containers are being recycled. A trailer hitch and brake line from the packer would be required to couple with the tow bar of the trailer. This trailer configuration is more prone to "jack-knife" than the semi-trailer "fifth wheel" system used with the half ton.

The compartmentalized trailers normally range from 15 to 20 cubic yard volume capacity and carry loads of from 1.5 to 2.5 tonnes, depending upon the mix of recyclable materials. The capital cost of the equipped half ton with the trailer, before taxes and shipping charges, will range from $40 to $50 thousand. The capital cost, before taxes and shipping charges, of the compartmentalized trailers with hydraulic dumps and air brakes will range from $17 to $22 thousand. Operating costs of the half ton with trailer system, including amortized capital of the half ton, trailer and equipment required amortized capital of the half ton, have been estimated to cost an average of $55.62 per hour. Operating costs of the packer (SL) with trailer system, including amortized capital of the packer and trailer and two operators have been estimated to cost an average of $69.28 per hour. Normally the garbage packer used in the packer/trailer system would be drawn from existing garbage collection vehicle fleets.

The advantages of compartmentalized recycling trailer systems are:

- relatively low capital costs of half ton/trailer system;
- hydraulic unloading of trailers;
- joint garbage and recyclables collection of packer/trailer system; and
- can make use of existing packer fleet, if available.

The disadvantages of compartmentalized recycling trailer systems are:

- poor maneuverability, particularly with the packer/trailer configuration;
- low capacity of trailers;
- two-person systems increase labour costs;
- the need for tarping of trailers;

- slow collection rates achieved, particularly packer/trailer system;
- packer/trailer system slows collection of garbage and restricts packer capacity to load levels attained in recyclable collection trailer; and
- complicated and cumbersome unloading operations involved with packer/trailer systems.

4.1.2 Drop-off Depots

There are several containers and even trailers available for drop-off depot recycling systems. However they all entail the same basic system elements, and therefore have similar costs. The drop-off depot recycling system elements include:

1. establishing drop-off depot system service areas;
2. locating depot sites;
3. preparing site grounds and access;
4. identifying recyclable materials to be deposited;
5. determining depot container system to be used;
6. establishing need for site maintenance and supervision.

1. Depot Service Areas

Resident participation in drop-off depot recycling systems diminishes rapidly as the distance increases from homes to a depot site. Therefore each community must have their own recycling depot in order to achieve at least average levels of diversion, at 3% of the waste stream. In urban areas, where population is concentrated, depots should be available for every 10,000 population. In New Brunswick, all small municipalities and LSD's should be provided a depot. For the five CPFSA's, the following numbers of required drop-off depots would be: 70 for CPFSA#1, 40 for CPFSA#2, 70 for CPFSA#3, 53 for CPFSA#4, and 72 for CPFSA#5.

2. Depot Site Locations

Depots should ideally be located at or near the centre of population being served. They should be well situated along common travel routes, but have safe and easy access to and from the site. Finding drop-off depot sites can be a difficult task in some communities due to the traffic generated and perceived nuisance.

3. Site Preparation

Drop-off depots should be designed to accommodate at least five vehicles at a time on site, provide ample circulation space for container collection trucks, have a paved or otherwise firm well-drained gravel surface, and allow for easy snow removal. The site should be well lighted for security and fenced in if not supervised.

4. Materials Identification

The site should provide proper signage for program identification and recyclable materials separation and deposit. Normally depots should be limited to handling no more then six materials for deposit into container compartments or separate bins, to avoid confusion and material contamination. For systems handling more than six materials, co-mingling of some materials would be recommended (eg. HDPE with PET bottles, newspapers with other papers, aluminum with steel cans, etc., but not types of glass, if clear and coloured glass are marketed separately, due to contamination from breakage).

5. Depot Container Systems

There are several types of containers available for drop-off depots, which include enclosed 20 cubic yard compartmentalized roll-off containers, and various types of small (2 to 4 cubic yard) individual material barrels, bins or dome-shaped "igloos". The roll-off containers are covered with top side hatches for deposit of the materials and a rear end door for dumping out materials. The "igloos" each have drop-in hatches located near the top of the dome, and are dumped from two centre opening doors at the bottom.

Typically, depot systems have the containers picked up for delivery to a CPF on a weekly or as required basis, which is provided by specialized one-person operated trucks. These trucks would serve several depots by going from one depot, unload the empty container(s) and load the filled container(s), take filled container(s) to the CPF and dump them, and return to the next depot on the circuit with the empty container(s) for exchange, and so on. The roll-off containers are hauled by tilt-frame trucks and hydraulicly dumped, one hinged compartment at a time. The "igloo" styled bins are hauled by trucks equipped with a crane system for loading and bottom hatch dumping.

6. Site Maintenance, Supervision and Costs

Recycling depots are subject to material contamination and vandalism, and operate best when supervised, but at very high cost. To reduce costs of staffing and mitigate contamination and vandalism problems at depot sites, proper lighting, fencing and gate locking procedures should be pursued. The depot truck operators can provide normal site maintenance as part of their responsibilities. Snow removal and annual site maintenance would be contracted out.

The capital cost of site work, lighting, fencing, signage, land and containers of each recycling drop-off depot site and container(s) would be from $40 to $50 thousand. The average cost of amortized capital and annual site maintenance would be $13 to $14 thousand per year for the depot sites. The capital cost of the depot collection trucks, before taxes and shipping charges, would range from $70 to $90 thousand. The operating costs of the depot collection trucks, including amortized capital and one operator, would average $45.51 per hour to $46.14 per hour.

An average cost of one dollar ($1) per participating household per drop-off has been added to reflect the average cost to residents of delivering their recyclables to a drop-off depot. Based on 50 percent household participation and trips to and from drop-off depots taken once every two weeks, the five CPFSA's average annual costs accounted to resident self-delivery of recyclable materials are: CPFSA1 - $409,000; CPFSA2 - $454,000; CPFSA3 - $810,000; CPFSA4 - $770,000; and CPFSA5 - $723,500. These resident delivery costs represent from between 19 percent and 27 percent of the estimated operating costs of an unsupervised residential drop-off depot system.

Drop-off depots have had some success in areas, where no other recycling opportunities have been made available, and residents have been anxious to participate in recycling. However, participation in depot systems has been found to steadily diminish over time, unless very concerted and continuous promotional efforts support the program. Depot systems must also be very well maintained to retain program credibility. Recyclable materials diversion rates of depot systems have been quite low and costs high relative to diversion levels.

4.2 ICI Recycling Collection Options

ICI recyclable materials can be collected in a wide variety of vehicles and are usually chosen by availability and for type of materials collected. ICI recycling systems have not yet been clearly defined and are still in the early developmental stage, but collection services can be categorized as follows:

1. Pick-up Service; and
2. Self Delivery Service.

4.2.1 ICI Recyclables Pick-up Service

ICI recyclables pick-up services may be provided by public programs to institutions businesses and industries as a public service. Pick-up services for ICI materials may also be provided by private collectors who pick-up recyclables either for their market value at no cost to the recyclable producers, or for a haulage fee from the producer. Several vehicles may be used for ICI recyclables pick-up services, but most commonly the following are used:

1. Cube vans;
2. Roll-off Containers/Trucks; and
3. Front Load Packers

1. Cube Vans

Cube vans would be used principally to pick up office papers and bagged mixed recyclable materials such as beverage containers. The firms using the service will collect papers and other materials in bins, bags or blue barrels, as stipulated by the pick up service program. Usually two persons would be used for ICI collection of these materials, but one person could perform both driving and loading functions. Cube vans picking up only or mostly papers will often carry heavier loads than when used for residential collection due to the density of papers, of up to 3.5 tonnes.

Capital costs of cube vans, before taxes and shipping charges, range form $28 to $35 thousand. A two-person operation, including amortized capital costs, costs an average of $54.29 per hour.

2. Roll-off Containers/Trucks

Roll-off containers can be either compartmentalized or compaction depending on the materials to be picked up. Containers are located on site of the firms utilizing the service, and are picked up on a prescheduled basis (weekly, bi-weekly, etc.), or as required when full. Compartmentalized containers permit material separation by the firm into the compartments, and therefore is appropriate to firms which generate a mixture of recyclable wastes. Compaction containers are most appropriate to firms which principally generate cardboard, but may be appropriate to other singly compactable recyclable materials, such as aluminum cans or tinned cans, etc.

Roll-off containers can range from 20 to 40 cubic yards in volume capacity. Compaction containers can carry from 3.0 to 5.0 tonnes of compacted materials and compartmentalized containers usually about 1.5 to 2.5 tonnes of loose sorted materials. Roll-off containers are picked up and replaced by one person operating a tilt-frame truck, which can also dump the materials at the central processing facility. The compaction containers require a stationary compactor unit located at the firm site, usually with a 2 cubic yard hopper to provide the compaction.

The containers capital costs, excluding taxes, range from $6 to $8 thousand and a 2 c.y. hopper stationary compactor will cost from $8 to $10 thousand. The capital cost of a tilt-frame truck, before taxes and shipping charges, ranges from $90 to $100 thousand. The operating costs of a roll-off compartmentalized container system will average $49.60 per hour and the roll-off compaction container system $50.50 per hour.

3. Front Load Packers

Front load packers, packer (FL), can be used to pick up single compactable materials such as cardboard, papers, cans, etc. from ICI recyclable generators. Materials are collected in 4, 6 or 8 cubic yard containers, ie. dumpsters, on site and dumped into the packer by one operator. A packer (FL) can carry up to 6.0 tonnes of compacted recyclable materials.

The dumpster containers cost up to $1000 and a 40 cubic yard packer (FL) costs in the range of $125 to $150 thousand, before taxes and shipping charges. The cost of operations of a packer (FL) pick-up system will average $55.42 per hour.

4.2.2 ICI Recyclables Self Delivery Services

ICI recyclables self-delivery services simply entail the collection and delivery of recyclables by the ICI firms' own vehicles and staff. Vehicles used for this approach are those available to the firm, normally half ton, one ton or three ton flatbed trucks with side boards. Materials are collected in bags or bins by the firm and delivered when a truckload has accumulated. Loads range from 0.25 tonnes for a half ton to up to 2.5 tonnes for a 3 ton, depending upon the mix of recyclable materials.

The capital costs of 1/2, 1 and 3 ton trucks, before taxes and shipping charges, are $16 to $20 thousand for 1/2 tons, $20 to $25 thousand for 1 tons, and $28 to $35 thousand for 3 tons. Operating costs, including amortized capital and one operator, but excluding overhead costs and profit, are estimated at $25.46 per hour for a 1/2 ton, $31.36 per hour for a 1 ton, and $33.94 per hour for a 3 ton truck.

5.0 RECYCLING SYSTEMS ANALYSIS

5.0 RECYCLING SYSTEMS ANALYSIS

This chapter provides the cost analysis of the range of recycling system options available for application to the large scale operations necessary to serve the Central Processing Facility Service Areas (CPFSA's) established under Scenario 1A (from Chapter 3.0). It integrates compatible processing and collection system operations according to anticipated recyclables diversion levels associated with the recycling system options. It also provides cost estimates of all component operations of the recycling systems and their respective recyclables diversion levels. The results of the recycling systems costs analyses are then assessed as parts of the total solid waste management system, which include non-recycling cost components.

After reviewing the studies completed to date for the solid waste management region committees (ie. waste audits, assessments of alternatives, etc.) and being in contact with the regional committee managers, it became apparent that in most cases the regions had not yet proceeded to the stage where the Study Team could dictate, or even recommend the "best" recycling approach for the regions. Most regions have yet to select a disposal site location, some had yet to choose a method of waste disposal, and some regions were just being formed and had no information or studies completed. To complicate matters further, it was established early on in this study that scale economies of combining regions would be achieved and should be pursued. This, therefore, will require joint decision-making among member regions of the recycling system CPFSA's, with respect to their mutual choices and preferences regarding recycling options. It was thereupon decided that a "plan" for recycling would be inappropriate. Instead this study adopted a "shot gun" approach and became directed towards establishing and analyzing the spectrum of recycling system options applicable to each of the five CPFSA's. This approach therefore, provides an analytical resource document of the range of recycling options and their costs applied to each CPFSA to be used by the solid waste management region committees in their decision-making process.

The chapter begins with a discussion of the Base Case and Sensitivity Tests evaluation parameters utilized in the analysis of recycling system options. The Base Case parameters reflect expected conditions and levels of performance provided by the basic recycling options. The series of Sensitivity Tests indicate the results of the recycling system options characteristics and performance, which vary from the Base Case parameters.

Once all of the Base Case and Sensitivity Test parameters have been established, the recycling collection systems analysis will be summarized. This will be followed by the results of the recycling systems costs and revenue estimates for each of the Base Case systems and the range Sensitivity Test Scenarios. The cost results will be reported for each of the five CPFSA's, as established for this study.

The analysis will conclude with a summary comparison of the three basic recycling systems. An example has been provided to demonstrate how these cost tables can be used to compare "on a level playing field" the following Base Case recycling systems applied to the Westmorland/Albert Solid Waste Management Region of CPFSA4:

1. Full Service System;
2. Minimum Service System; and the
3. MaxRF (Wet/Dry) Service System.

The collection and processing costs of these basic recycling systems will be assessed along with all other non-recyclable wastes collection and waste disposal requirements to provide a balanced view of the recycling systems within the entire waste management system operations.

The applied example will serve as a guide to regional waste managers in assessing their individual solid waste management regions costs as part of their larger CPFSA region.

5.1 Base Case and Sensitivity Evaluation Parameters

This section establishes the Base Case and Sensitivity Test parameters used in the cost analysis of recycling system options.

5.1.1 Base Case Parameters

The Base Case evaluation recycling system options parameters have been developed using the most up-to-date and reliable information attained through review of published material and a survey of recycling operations. The underlying premise of the Base Case parameters is that the options are representative of typical, successful and well promoted and endorsed programs. In addition, the Base Case offers a range of recycling system options incorporating the spectrum of conventional and state-of-the-art recycling approaches. The costs of the Base Case systems will be estimated for each CPFSA of the Province to indicate their respective performance and efficiencies.

The preliminary evaluation of CPFSA scenarios concluded that the Province could be most efficiently and effectively served by large scale recycling systems. Scenario 1A produced the least-cost combination of plant scale versus line haul transportation costs, and will be used exclusively hereon for the Base Case and Sensitivity Test evaluations. Scenario 1A is comprised of 5 CPFSA's as indicated in **Table** 5.1 and shown previously in **Figure** 3.1.

The Base Case evaluation parameters include:

1. A set of recyclable materials, Residential and ICI;
2. The composition of recyclable materials within the Residential and ICI waste stream;
3. The percentage recovery of the recyclable materials by Residential and ICI programs;
4. The set of typical representative recyclables collection systems, Residential and ICI;
5. Average diversion rates of recycling collection systems, Residential and ICI;
6. Average diversion rates of recyclable materials collected by the recycling systems; and
7. Average delivered market prices for New Brunswick recyclable materials.

Following are the Base Case parameters as developed.

1. Base Case Recyclable Materials

The Base Case set of recyclable materials are comprised of those materials presently collected in the Province from residential and ICI systems, and which have established markets accessible to New Brunswick. Residential recyclable materials include newspaper, clear glass, aluminum cans and PET, HDPE and film plastics.

TABLE 5.1

SOLID WASTE TONNAGES GENERATED PER CPFSA IN NEW BRUNSWICK
(Scenario 1A)

Annual Solid Wastes Generated (tonnes)	Central Processing Facility Service Areas[1]				
	CPFSA1	CPFSA2	CPFSA3	CPFSA4	CPFSA5
Residential Wastes:	28,925	41,374	71,826	45,743	51,817
ICI Wastes:	21,042	34,112	71,165	54,101	56,484
Total All Wastes:	49,967	75,486	142,991	99,844	108,301
Total Households:	31,462	34,900	62,291	59,205	55,656

[1]

CPFSA#1:	Madawaska/Victoria Region; western part of Restigouche County not included in Restigouche Region; Carleton/Victoria Region; and southwest portion of York County south of Saint John River not included in Fredericton or Charlotte Regions.
CPFSA#2:	Fredericton Region; northern York County north of Saint John River not included in Fredericton Region; Sunbury County not included in Fredericton Region; and northeast portion to Chipman of Queens County not included in Fredericton Region.
CPFSA#3:	Fundy Region; Kings County Region; Charlotte Region; and the portions of Queens County east of Chipman and south of Gagetown.
CPFSA#4:	Westmorland/Albert Region; and Kent Region.
CPFSA#5:	Northumberland Region; Acadian Peninsula Region; Nepisiguit/Chaleur Region and Restigouche Region.

Note: See Figure 3.1 for a map of Scenario 1A CPFSA's.

ICI recyclable materials include ledger paper, computer print-out paper, coloured paper, mixed paper and cardboard.

2. Composition of Recyclables

The composition of residential recyclable materials have been adopted from the R. Cave and Associates waste audit of Guelph, Ontario, 1989. This waste audit provides a recent representation of residential wastes broken down into material categories suitable to this study. Material composition data from Seattle, Washington, 1989 were used for the ICI waste stream. Very few recent data sources for waste composition are available at present, particularly those which provide useful material breakdowns and separation of residential and ICI waste streams. These waste composition data indicate only the proportions of materials available within the waste streams, as shown in **Table 5.2**. They are used in this study only to factor the percentage of potential recyclable materials not presently recovered within a recycling program.

3. Recyclable Materials Recovery

Residential and ICI recovery data are available from the Fredericton recycling programs for the Base Case materials, as well as several other programs throughout Canada and the U.S. These data indicate the percentages by weight of recyclables recovered as a proportion of all recyclables recovered. Upon review of the various recycling programs, the typical material recovery proportions were concluded to be as follows:

Residential Recovery	
Newspaper	72%
Clear Glass	20%
Aluminum Cans	1%
PET Bottles	1%
HDPE Plastic	5%
Plastic Film Bags	1%

ICI Recovery	
Cardboard	65%
Ledger Paper	12%
Computer Print-out Paper	5%
Coloured Paper	9%
Mixed Paper	9%

TABLE 5.2

WASTE STREAM COMPOSITION BREAKDOWNS

Waste Composition	Residential (%)	ICI (%)
Newspaper	16.4	1.9
Glossy Paper	5.1	0.0
Fine Paper	1.9	7.2
Boxboard	3.1	0.0
Mixed Paper	4.7	15.8
Cardboard	2.6	13.4
Plastic Film	2.4	0.2
Plastic Containers	1.2	0.9
Foam	0.2	0.0
PET Plastic	0.1	0.0
Other Plastics	1.0	6.7
Ferrous Metals	3.8	3.8
Non-Ferrous Metals	0.8	0.4
Glass Clear	4.1	2.3
Glass Coloured	2.1	1.1
Non-Container Glass	0.3	0.0
Ceramics	0.7	0.0
Multi-Layer Packages	2.3	0.0
Wood	0.6	8.9
Textiles	2.0	2.8
Inserts	2.3	3.4
Rubber	0.2	0.0
Leather	0.1	0.0
Food Waste	27.3	16.8
Yard Waste	4.9	13.9
Sanitary Products	0.2	0.0
Diapers	2.7	0.0
Pet Droppings	1.1	0.0
Ashes	1.0	0.0
Vacuum Catching	0.2	0.0
HHD Hazardous Waste	0.3	0.0
Residual	4.3	0.4

Source: R.Cave & Associates Ltd., 1989.

The proportions of materials recovered in residential recycling programs are relatively consistent and predictable.

The recovery of ICI recyclable materials are dependent upon the mixture of industry versus commercial and institutional predominance of an area. It also hinges on the type of collection services offered, if any, for the ICI wastes. In Fredericton, where papers are amply available due to the high proportion of institutional and commercial office sectors, picked up at no charge, and OCC is accepted without a tipping fee, the proportions are 61 percent cardboard and 39 percent paper recovered in their recycling program. In Guelph, Ontario, where agrifood industries high in packaging predominate, the proportions recovered from ICI are 80 percent OCC and 20 percent papers. A 65 and 35 percent split of ICI cardboard to papers has been adopted for this study.

4. Recycling Collection Systems

Residential recycling collection systems evaluated in this study are roadside collection blue box, blue bag and stackable bins systems and drop-off depot systems. Each system has a variety of collection vehicles and service level options available. The Base Case will assume a weekly pick-up service of roadside collection systems, and an "as required" or minimum weekly pick-up of compartmentalized roll-off containers for the depot system. Power loaded specially designed recycling vehicles (SDRV-PL), will act as the Base Case vehicle of blue box and stackable bin systems. Low compression packers will be used in the Base Case for the blue bag system.

ICI recycling collection systems evaluated in this study are pick-up services and self delivery. The Base Case pick-up service vehicles are cube vans for papers, and front-load packers and roll-off compaction containers for cardboard. The Base Case self-delivery vehicles are open box half, one and three ton trucks, as available to businesses for other uses.

5. Recycling Systems Diversion Rates

Diversion rates of recycling systems hinge on a variety of factors such as community reception, contamination content, level of service provided and level of program promotion, etc. Review of residential diversion rates for the four collection systems indicate typical diversion rates of 3 percent for depot systems. The typical diversion of blue box, blue bag and stackable bin systems, offered weekly in conjunction with garbage pick-up and with concerted promotion efforts, is 15 percent. These diversion rates will be used as the Base Case for residential recycling systems in this study.

ICI diversion rates are not well documented because waste authorities are often not involved in the ICI recycling programs. In such cases they are collected by private operators led by either profitability or various incentives, such as payment at recovery facility, no tipping fee charged, and non-acceptance at disposal sites, etc. In this study the Base Case ICI collection systems will assume no direct charge to businesses with well promoted and received programs. The diversion rate for a pick-up service is estimated to be 25 percent, whereas a self-delivery system would be expected to divert only 5 percent of the ICI waste stream.

6. Recyclable Materials Diversion Rates

Based on the proportion of each recyclable material to the total Base Case set of residential and ICI materials recovered, and the Base Case diversion rates of each recycling collection system option, recyclable material diversion rates have been estimated. These Base Case recyclable materials diversion rates are shown in **Table 5.3**.

7. Market Prices

Market prices of the Base Case set of recyclable materials have been established from current typical average prices offered by the industrial consumers of the materials. The market prices for recyclables provided in **Table 5.4** reflect FOB (Free on Board) Destination prices, as paid by the consumers at their plant. The net prices presented in **Table 5.4** provide the average net revenues which would be received by the CPF's net of the transportation costs of delivering the materials to their markets, based on full tractor-trailer load shipments of compacted, bundled and/or crushed materials, as specified.

TABLE 5.3

RECYCLABLE MATERIALS DIVERSION RATES - BASE CASE

Residential Recyclables	Residential Collection Systems			
	Depot	Blue Box	Blue Bag	Stackable Bins
Newspaper	2.16%	10.8%	10.8%	10.8%
Clear Glass	0.60%	3.0%	3.0%	3.0%
Aluminum Cans	0.03%	0.15%	0.15%	0.15%
PET Plastics	0.03%	0.15%	0.15%	0.15%
HDPE Plastics	0.15%	0.75%	0.75%	0.75%
Plastic Film Bags	0.03%	0.15%	0.15%	0.15%
Total Residential	**3.0%**	**15.0%**	**15.0%**	**15.0%**

ICI Recyclables	ICI Collection Systems	
	Pick-up Service	Self-Delivery
Cardboard (OCC)	16.25%	3.25%
Ledger Paper	3.0%	0.60%
Computer Print-out Paper	1.25%	0.25%
Coloured Paper	2.25%	0.45%
Mixed Paper	2.25%	0.45%
TOTAL ICI	25.0%	5.0%

TABLE 5.4

RECYCLABLE MATERIAL PRICES - BASE CASE

	Market Prices ($/T) (FOB Destination)	Net Prices ($/T) (FOB Origin)
RESIDENTIAL RECYCLABLES		
Newspaper	–	$35
Clear Glass	$75	$50
Aluminum Cans	$1,000	$815
PET Plastics	$300	$165
HDPE Plastics	$140	$55
Plastic Film Bags	$440	$410
ICI RECYCLABLES		
Cardboard (OCC)	$65	$35
Ledger Paper	–	$200
Computer Print-out Paper	–	$250
Coloured Paper	–	$140
Mixed Paper	–	$5
MAX RF Compost	–	$9

5.1.2 Sensitivity Test Evaluation Parameters

The Sensitivity Tests have been designed to encompass the range of possibilities which would affect the costs and effectiveness of the recycling system options, as applied to the CPFSA's. Variations from the Base Case in the vehicles used for recyclables collection, service levels, diversion rates, the materials to be recycled and market prices have been predicated on experience attained locally and elsewhere. The range of Sensitivity Test parameters represent alternative system choices and outcomes of variations to the Base Case parameters.

1. Alternative Recycling Collection Vehicles

Vehicle alternatives for the three residential roadside collection systems are abundant, although the Base Case vehicles are either the most common or have been proven to be efficient. There are variations in containers used in drop-off depot recycling systems, but they vary little in effectiveness or costs; so only the Base Case compartmentalized roll-off container system have been evaluated. The following lists the alternative residential collection vehicles per recycling system to be tested in the sensitivity evaluation.

i) Blue Box - Base Vehicle: -SDRV - PL (power load)
- Alternative Vehicles: - SDRV - ML (manual load)
- Cube Vans
- Packer with Recycle Trailer
- Half Ton with Recycle Trailer

ii) Blue Bag - Base Vehicle: - Packer - SL (side load)
- Alterative Vehicle: - Packer - RL (rear load)

iii) Stackable Bins- Base Vehicle: - SDRV - PL
- Alternative Vehicle: - SDRV - ML

The Base Case ICI recyclable collection assumes appropriate vehicles are used for the recyclable materials, due to the various material sources (eg. cardboard from shopping malls and paper from offices, etc.). For ICI programs, which include materials other than cardboard and papers, pick-up service would include compartmentalized roll-off containers for at source recyclables separation by the ICI firms.

2. Service Level Variations

Alternatives exist with respect to the frequency and extent of services provided for residential recyclables collection. Bi-weekly and monthly collection services will be tested for the blue box three residential recyclable collection system. In addition the combination of urban provided roadside collection with depot service only in rural areas of the Province have been tested; as has the case where blue box roadside collection recycling services are provided only in urban areas of the Province.

3. High and Low Scenario Diversion Rates

Diversion rates for high and low scenarios of the Base Case set of recyclable materials are shown in **Table 5.5**. They have been estimated based on the upper and lower range of rates experienced by systems elsewhere. The high scenario diversion rates are predicated on high residential and ICI participation and reception, and low contamination through high levels of promotion and incentives. The low scenario diversion rates assume Base Case levels are not realized due to various factors such as higher contamination content, lower participation and a lack of incentives or continued program promotion. These diversion rates have been set so as to capture the range of possibilities from the minimum acceptable to the maximum possible diversion of recyclable materials from the waste stream. All diversion rates have been allocated among the Base Case set of recyclables in proportion to their recovery levels and composition within the waste stream.

4. Other Recyclable Material Combinations

Three scenarios of alternative combinations of residential recyclable materials are provided in relation to the Base Case set of materials (ie. newspaper, clear glass, aluminum cans, and PET, HDPE and film plastics). They are:

i) Group 1: The Base Case set of recyclable materials plus tin cans, coloured glass, cardboard and boxboard. These materials can be co-collected within the conventional recycling collection systems. These

TABLE 5.5

RECYCLABLE MATERIALS DIVERSION RATES - SENSITIVITY ANALYSIS HIGH AND LOW SCENARIOS

Residential Recyclables	RESIDENTIAL COLLECTION SYSTEMS			
	High Scenario		Low Scenario	
	Depot	Roadside Collection	Depot	Roadside Collection
Newspaper	3.60%	18.0%	1.44%	7.20%
Clear Glass	1.0%	5.0%	0.40%	2.0%
Aluminum Cans	0.05%	0.25%	0.02%	0.10%
PET Plastics	0.05%	0.25%	0.02%	0.10%
HDPE Plastics	0.25%	1.25%	0.10%	0.50%
Plastic Film Bags	0.05%	0.25%	0.02%	0.10%
Total Residential	5.0%	25.0%	2.0%	10.0%

- -

ICI Recyclables	ICI COLLECTION SYSTEMS			
	High Scenario		Low Scenario	
	Pick-up	Self-Delivery	Pick-up	Self-Delivery
Cardboard (OCC)	22.25%	13.00%	6.50%	0%
Ledger Paper	4.20%	2.40%	1.20%	0%
Computer Print-out Paper	1.75%	1.00%	0.50%	0%
Coloured Paper	3.15%	1.80%	0.90%	0%
Mixed Paper	3.15%	1.80%	0.90%	0%
TOTAL ICI	35.0%	20.0%	10.0%	0%

materials are presently not collected in existing residential recycling programs in the Province.

ii) Group 2: The Base Case set of recyclable materials plus white goods, tires, wood, and other metals. These materials require special collection semi-annually (ie. spring and fall) using open-top trucks due to their irregular dimensions, generation rates and volumes.

iii) Group 3: The Base Case set of recyclable materials less the glass, aluminum cans and PET bottles used for beverage containers, as removed from the residential waste collection stream by the proposed Beverage Container Legislation.

One alternative combination of materials has been tested for ICI recycling. It is composed of the Base Case ICI set of recyclables (ie. cardboard and ledger, computer print-out, coloured and mixed papers) plus the addition of clear glass, aluminum cans, mixed plastics, wood and tires.

Table 5.6 presents the estimated diversion rates of these alternative sets of recyclable materials. The diversion rates have been estimated based on their availability within their respective residential and ICI waste streams, and factored in proportion to the Base Case diversion rates. Diversion rates for each of the base system options, residential depots and roadside collection and ICI pick-up and self-delivery, are also provided in **Table 5.6**.

5. Market Price Variations

Market and net prices have been established for the additional sets of residential and ICI recyclable materials, previously identified. They are presented in **Table 5.7**. It should be noted that no credible markets are presently available for tires and mixed glass. A tire recycling plant exists in Mississauga, Ontario, but the delivered market prices are below their estimated shipping costs from New Brunswick. Although markets are known to exist for mixed glass, no local consumer presently accepts mixed glass. Market prices of mixed glass elsewhere would not compensate for their transportation costs.

TABLE 5.6

RECYCLABLE MATERIALS DIVERSION RATES - SENSITIVITY WITH RECYCLABLES ADDED AND EXCLUDED FROM BASE CASE

Residential Recyclables	Residential Collection Systems	
	Depot	Roadside Collection
Base Case Set (newspaper, clear glass, aluminum cans, and PET, HDPE and film plastics)	3.0%	15.0%
Group 1: With Additional Co-Collected Materials (tin cans, coloured glass, cardboard and boxboard)	4.2%	21.0%
Group 2: **With Additional Specially Collected Materials** (white goods, tires, wood and other metals)	3.6%	18.0%
Group 3: With Materials Excluded by Beverage Container Legislation (clear glass, PET bottles and aluminum cans)	2.64%	13.2%

ICI Recyclables	ICI Collection Systems	
	Pick-up	Self-Delivery
Base Case Set (cardboard and ledger, computer print-out, coloured and mixed paper)	25.0%	5.0%
With Additional Co-Collected Materials (clear glass, aluminum cans, mixed plastics, wood and tires)	39.15%	7.83%

Table 5.7

RECYCLABLE MATERIAL PRICES - SENSITIVITY ANALYSIS - PRICES OF ADDITIONAL RECYCLABLES
(\$ per Tonne)

Residential Recyclables	Market Prices (\$/T) (FOB Destination)	Net Prices (\$/T) (FOB Origin)
Tin Cans	\$80	\$25
Coloured Glass	\$40	\$15
Mixed Glass	n.a.	n.a.
Boxboard	\$50	\$20
White Goods	—	\$5
Tires	n.a.	n.a.
Wood (chipped)	—	\$22
Ferrous Metals	—	\$35
ICI Recyclables		
Clear Glass	\$75	\$50
Aluminum Cans	\$1000	\$815
Mixed Plastics	\$60	\$30
Tires	n.a.	n.a.
Wood (Chipped)	—	\$22
MAX RF Compost	—	\$9

Table 5.8 presents the high and low scenarios, plus and minus 20 %, respectively, for the Base Case set of recyclable materials net prices (ie. FOB origin). The limits of 20 % were sufficient to incorporate any price ranges offered by material consumers, as well as their speculated near future price changes. Higher prices for recyclables can be expected, if new recycling factories come on stream in this region, opening new or expanded consumer markets. Alternatively, lower prices or even loss of markets can be expected, if new recycling factories are not established or existing consuming facilities expanded to accommodate the inflow of recyclable materials generated by the Province-wide establishment of recycling systems.

5.1.3 Wet-Dry Recycling Systems

Base Case and Sensitivity Tests evaluation runs have been established for fourth generation (wet-dry) maximized recycling systems to be analyzed along with the conventional dry material recycling systems.

1. Base Case Wet-Dry Recycling

Because wet-dry recycling systems collect and deliver 100 percent of all wastes to a MaxRF plant for processing, the Base Case for maximized recycling includes collection of all recyclable dry materials and all wet materials. Only non-recyclable or contaminated dry wastes and hazardous or non-compostable wet materials would be excluded as residual wastes from the base case set of recyclable materials for wet-dry recycling systems. The amounts of each recyclable material recovered would be in approximately the same proportions as exist within the residential and ICI waste streams provided in **Table** 5.2, previously.

Table 5.9 provides the percentages of dry and wet recyclable materials available and recoverable from both the residential and ICI waste streams. The dry and wet materials available are those that enter the plant from the waste stream. In the case of dry materials those recyclable dry materials are accounted in the recovery rate. On average, only 62% of residential and 66% of ICI dry recyclable materials available can be recovered due to contamination and loss. In total 30% of the residential and 41% of the ICI waste streams would be recovered in the dry recycling plant. Similarly, an average of 80% of residential and ICI wet materials received can be composted. Therefore 30% of the residential and 25% of the ICI waste streams would be recovered in the composting plant. In total 60% of the

Table 5.8

RECYCLABLE MATERIAL PRICES - SENSITIVITY ANALYSIS OF HIGH AND LOW SCENARIOS

($ per Tonne)

Residential Recyclables	Net Prices (FOB Origin) High Scenario (+20%)	Net Prices (FOB Origin) Low Scenario (-20%)
Newspaper	$42	$28
Clear Glass	$60	$40
Aluminum Cans	$978	$652
Pet Plastics	$198	$132
HDPE Plastics	$66	$44
Plastic Film Bags	$492	$328
ICI Recyclables		
Cardboard	$42	$28
Ledger Paper	$240	$160
Computer Print-out Paper	$300	$200
Coloured Paper	$168	$112
Mixed Paper	$6	$4
MAX RF Compost	$200	$0

Table 5.9

RECYCLED MATERIALS COMPOSITION AT MAX RF PLANTS

	Residential	ICI
Dry Materials Available from Waste Stream:	62%	69%
- Recyclables	49%	62%
- Non-Recyclables	13%	7%
% of Recovery of Recyclables at Plant:	62%	66%
% Dry Recyclables Recovery from Waste Steam:	30%	41%
Wet Materials Available from Waste Stream:	38%	31%
% Recovery of Compostable material at plant:	80%	80%
% Compost Recovery from Waste Stream:	30%	25%
Total Wet/Dry Recovery from Waste Stream:	60%	66%

residential and 66% of the ICI waste streams would be recycled using a wet-dry system.

The Base Case residential collection system for wet-dry systems is comprised of two wheeled containers sorted at the home. The residential wheeled containers would be picked up on a weekly basis by a two-compartment SDRV-PL recycling vehicle. ICI collection would be comprised of a composite of vehicles as chosen by the producer depending upon the type of waste. Cube vans, front-load packers, roll-off containers, and half, one and three ton trucks would be used for delivery of ICI wastes. There would be no need to distinguish self-delivery from pick-up services, as all wastes would be collected and delivered to the MaxRF plant. ICI firms would be expected to separate their wet and dry wastes prior to delivery.

The average market and net prices of the dry recyclable materials are the same as those provided in **Tables** 5.4 and 5.7, previously. The compost markets are less definitive and yet to be proven. For this analysis $9 per tonne at the plant has been assumed as a representative price for bulk compost as a competitive material to topsoil.

2. Sensitivity Evaluation of Wet-Dry Recycling

Since 100% of the waste stream is collected and delivered to the MaxRF plant in a wet-dry recycling system there is no variation in diversion levels, which would affect collection or processing costs. However, there are optional approaches to the collection and market values of wet-dry materials.

Two alternate residential collection approaches are:

1. weekly co-collection of wet and dry bags in a low compression packer; and

2. weekly separate collection of wet bags and dry bags by two low compression packers or one packer twice.

No alternate ICI collection systems need be tested for wet-dry systems.

Table 5.8 provided the price variation scenarios for recyclables and compost. Market prices of dry recyclables could vary by plus or minus 20 percent, as assumed previously. Market prices of compost would vary from a possible zero price to $200 per tonne. If no markets are available for compost, it would have no monetary value, but could be used as landfill cover or made available at no change to any consumer on a pick-up basis from the plant. It could also be possible that compost might become competitive with peat moss markets, and therefore command a price of as much as $200 per tonne.

5.2 Base Case Analysis

This section provides the results of the Base Case recycling systems analysis.

5.2.1 Base Case Analysis Setup

In order to provide a complete assessment of the costs of recyclables processing and collection costs and recyclable materials revenue, it was necessary to pair Base Case residential systems with Base Case ICI systems. The diversion levels of ICI recycling approaches are necessary elements of the processing costs and materials revenues. Although ICI recycling collection costs may not be a public responsibility, to achieve greater recyclables diversion and processing economies and revenues, ICI recycled materials must be included. As pointed out in the previous section there are three principle residential recycling systems and two ICI recycling systems. These Base Case Systems represent the range of recycling program service and activity levels from the standpoint of collection, processing, diversion and revenue levels. The Base Case analysis of the paired recycling systems includes:

1. Residential Roadside Collection with ICI Pick-up Service (Full Service).
2. Residential Drop-off Depots with ICI Self-delivery (Minimum Service); and
3. Residential Roadside MaxRF Collection with ICI MaxRF Pick-up and Self-delivery (MaxRF Wet-Dry Service).

1. Full Service Recycling System: Residential Roadside Collection with ICI Pick-up Service

Residential roadside collection programs are of three types - blue box, stackable bins and blue bag. Each of the systems have for the Base Case been assumed to divert 15% by weight of the residential waste stream. Blue box and stackable bin programs are collected in SDRV-PL trucks and the blue bag program in a Packer-SL truck in the Base Case. These residential roadside collection programs collect newspapers, clear glass, aluminum cans, PET bottles, HDPE plastic, and plastic film bags in the Base Case.

Accompanying the residential roadside collection programs in the Base Case is the ICI pick-up service recycling. ICI recyclables pick-up service has been assumed to divert 25% by weight of the ICI waste stream. Cube vans, compaction containers and Packers-FL would be used to pick-up cardboard and papers (ie. ledger, computer print-out, coloured and other mixed papers).

The combination of these two joint residential and ICI recyclables collection programs provides a Full Service recycling system and constitutes a medium level of diversion.

2. Minimum Service Recycling System: Residential Drop-off Depots with ICI Self-Delivery

Residential drop-off depots are represented in the Base Case by a roll-off compartmentalized container/tilt-frame truck recycling system. Drop-off depot diversion in the Base Case has been assumed to be 3% by weight of the residential waste stream. As with roadside collection, the Base Case residential depots will accept newspaper, clear glass, aluminum cans, PET bottles, HDPE plastics and plastic film.

Accompanying the residential drop-off depot program in the Base Case is ICI self-delivery of recyclable materials (ie. cardboard and the various papers). Vehicles utilized are those owned by the participating firms, typically 1/2, 1 and 3 ton trucks. Diversion by the ICI self-delivery approach has been assumed for the Base Case to be 5% by weight of the ICI waste stream.

The combination of residential drop-off depot and ICI self-delivery recyclables collection provides a minimum service recycling system and constitutes a low level of diversion.

3. MaxRF Service Recycling System: Residential MaxRF Roadside Collection with ICI MaxRF Services

The Base Case MaxRF residential recycling program is a roadside collection system similar to the blue box or stackable bin system. Two wheeled containers, one for wet and the other for dry wastes, are collected and separately emptied into a two compartment SDRV. Although all wastes are collected, 60% of the total weight of the residential waste stream would actually be sorted and diverted as recyclable materials and compost. In other words, 40% of the residential waste stream composed of non-recyclable materials and other contaminated residual wastes would require disposal at a landfill site or by incineration. All uncontaminated recyclable materials available would be recycled in a MaxRF residential program.

Accompanying the Base Case residential MaxRF program would be a combination of pick-up service and self-delivery of ICI wastes to the MaxRF plant. These ICI recycling approaches would be essentially the same as with the ICI recycling of cardboard and papers, except that all waste materials would be included. The ICI firms would be required to separate wet and dry materials. Plant separation of recyclable materials and processing of compost would yield 66% diversion by weight of the ICI waste stream.

The MaxRF (wet-dry) Service recycling system approach to residential and ICI recycling constitutes the highest level of diversion.

Table 5.10 presents the estimated tonnages of residential and ICI recycled wastes diverted from each of the five CPFSA's by the three Base Case recycling systems. These diversion levels have been used in the ensuing Base Case analyses.

5.2.2 Processing Costs

Processing plant capital and operating costs were provided in **Chapter** 3.0 for a range of four different capacity CPF, which included a Materials Bulking Facility, and two sized MaxRF plant options. These plants were analyzed according to

Table 5.10
Base Case Recycling Systems Diversion

Base Case Recycling Systems	Recyclables Diversion (Tonnes)(1) CPFSA1	CPFSA2	CPFSA3	CPFSA4	CPFSA5
1. Full Service:					
Residential Roadside Collection - 15%	4,339	6,206	10,774	6,861	7,773
ICI Pick-up Service - 25%	5,261	8,528	17,791	13,525	14,121
Total Residential and ICI	**9,599**	**14,734**	**28,565**	**20,387**	**21,894**
2. Minimum Service:					
Residential Drop-off Depots - 3%	868	1,241	2,155	1,372	1,555
ICI Self-delivery 5%	1,052	1,706	3,558	2,705	2,824
Total Residential and ICI	**1,920**	**2,947**	**5,713**	**4,077**	**4,379**
3. MaxRF (Wet-Dry) Service:					
Residential MaxRF Collection - 60%	17,332	24,791	43,038	27,409	31,049
ICI MaxRF Services - 66%	13,985	22,671	47,296	35,956	37,539
Total Residential and ICI	**31,317**	**47,462**	**90,334**	**63,365**	**68,588**

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(1) Table 5.1 provides the total Residential and ICI solid wastes generated by the CPFSA's.

their respective throughput levels and the availability of recyclable materials from each CPFSA. The most appropriate plant was selected according to the combination of plant throughput capacity per shift, and operation of the plant of up to the maximum of three shifts per day. The operations costs for the resulting plant and shift schedules were also estimated.

Table 5.11 presents the planning cost estimates of the selected plants for each of the five CPFSA's according to the Base Case diversion levels. Preliminary estimates of the total plant capital, annual amortized capital, annual plant operation and total annual plant costs are provided, as well as the plant selected for each CPFSA.

The CPF#1 plant, the 100 tonne per day central processing facility, provides sufficient throughput capacity within one to three shift operations to fulfil the processing requirements of all five CPFSA's under the Base Case Full Service (ie. Residential Roadside Collection/ICI Pick-up Service) recycling systems. For the Base Case Minimum Service (ie. Residential Drop-off Depots/ICI Self-Delivery) recycling system, the CPF#4: 7500 tonne per annum Materials Building Facility, would be sufficient for all CPFSA's. For the Base Case MaxRF (Wet-Dry) Service recycling system the large MaxRF would be required to process materials generated by CPFSA3 and CPFSA5, the small MaxRF would be sufficient to the processing needs of CPFSA1 and CPFSA2. The Small MaxRF would also provide enough capacity in its dry recycling plant to process the recyclables generated by CPFSA4, with three-shift around the clock operations, but would require expansion of the wet composting plant to process the wet wastes of CPFSA4.

It should be noted that the MaxRF plants receive all residential and ICI wastes for recyclables processing, and actually reduce waste disposal requirements by between 60 and 66% of the entire waste stream. Therefore direct comparisons with the CPF recycling systems processing costs are not valid without considering all components of waste management. **Section** 5.4 will demonstrate how valid comparisons between CPF and MaxRF recycling systems can be made.

5.2.3 Collection Costs

Collection costs for residential and ICI recycling systems have been estimated using the N.B. Department of the Environment SWATMODEL, adapted to the unit costs

Table 5.11
Base Case Recycling Plant Processing Costs

Base Case Recycling Systems(1)	Recycling Plant Processing Costs CPFSA1	CPFSA2	CPFSA3	CPFSA4	CPFSA5
1. Full Service: (Residential Roadside Collection (15%) ICI Pick-up Services (25%))					
Plant Type:	*CPF #1*	*CPF #1*	*CPF #1*	*CPF #1*	*CPF #1*
Total Capital	$3,000,000	$3,000,000	$3,000,000	$3,000,000	$3,000,000
Annual Capital(2)	$397,620	$397,620	$397,620	$397,620	$397,620
Annual Operations	$518,620	$567,550	$855,347	$638,444	$655,409
Annual Processing	$916,240	$965,170	$1,252,967	$1,036,064	$1,053,029
2. Minimum Service: (Residential Drop-off Depots (3%) ICI Self-Delivery (5%))					
Plant Type:	*CPF #4*	*CPF #4*	*CPF #4*	*CPF #4*	*CPF #4*
Total Capital	$1,085,000	$1,085,000	$1,085,000	$1,085,000	$1,085,000
Annual Capital	$145,058	$145,058	$145,058	$145,058	$145,058
Annual Operations	$265,000	$341,405	$358,475	$341,405	$341,405
Annual Processing	$410,058	$486,463	$503,533	$486,463	$486,463
3. MaxRF (Wet-Dry) Service(3): (Residential Roadside Collection (60%) ICI Pick-up/Self-Delivery (66%))					
Plant Type:	*Small*	*Small*	*Large*	*Small(4)*	*Large*
Total Capital	$9,095,900	$9,095,900	$25,115,800	$11,096,000	$25,115,800
Annual Capital	$1,217,748	$1,217,748	$3,362,473	$1,485,506	$3,362,473
Annual Operations	$1,793,433	$2,078,975	$3,532,959	$2,892,559	$3,313,473
Annual Processing	$3,011,181	$3,296,723	$6,895,432	$4,378,065	$6,675,946

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(1) Bracketed percentages indicate recyclable diversion from waste stream of Base Case recycling systems.

(2) Capital ammortized at 12% over 5 years. Provincial capital grant not included.

(3) Direct comparisons of MaxRF with other recycling systems are not valid without consideration of all costs. See section 5.4 for cost comparison of recycling systems on an equal basis.

(4) CPFSA4 can use the small MaxRF plant, but with expansion to the composting facility.

and operational parameters of recycling system vehicles, as provided in **Chapter 4.0**. **Table 5.12** presents the collection costs of the three Base Case Residential/ICI recycling systems - Full Service (using the Residential Blue Box SDRV-PL Roadside Collection System), Minimum Service and MaxRF (Wet-Dry) Service. Collection costs of the Full Service and Minimum Service recycling systems include only the costs of the parallel recyclables collection services over and above the costs of other solid wastes collection and delivery for disposal, or residual wastes transferred from the CPF's for disposal. The MaxRF recycling system includes the cost of collection of all solid wastes delivered to the MaxRF for processing, but does not include the costs of transporting the non-recyclables and residual wastes from the MaxRF for disposal.

As was the case with processing costs, valid comparisons with the MaxRF recycling collection system cannot be made without including collection costs of all wastes of the Full Service and Minimum Service recycling collection systems, as included in the MaxRF collection costs. Qualified comparisons will be made among the three Base Case recycling systems in **Section 5.4**.

5.2.4 Recyclable Materials Revenue

Revenues from the sales of recyclable materials have been calculated based on the average market prices, net of transportation cost, and the tonnes of materials diverted by the recycling systems, net of residual loss. **Table 5.13** presents the revenues received form the three Base Case Residential/ICI recycling systems by the five CPFSA's. Once again, for valid comparisons among systems, refer to **Section 5.4**

5.2.5 Base Case Systems Costs and Revenues Summary

Tables 5.14 to **5.18** summarize the Base Case Recycling System costs and revenue components for each of the five CPFSA's, respectively. It is important that direct cost comparisons not be made between the Full Service and Minimum Service Base Case Recycling Systems and the MaxRF (Wet-Dry) Service Base Case Recycling System. The MaxRF recycling system includes the collection costs of all residential and ICI solid wastes delivered to the processing plant. Therefore only the non-recyclable and residual wastes need be transferred on for disposal. On the other hand the Full Service and Minimum Service recycling systems include only the

Table 5.12
Base Case Recycling Systems Collection Costs

Base Case Recycling Systems(2)	Collection Costs(1) CPFSA1	CPFSA2	CPFSA3	CPFSA4	CPFSA5
1. Full Service:					
Residential Roadside Collection (Blue Box SDRV-PL) (15%)	$1,510,590	$1,256,730	$2,231,210	$1,939,630	$2,493,580
ICI Pick-up Service (25%)	$786,510	$790,870	$1,388,640	$1,093,240	$1,486,980
Total Full Service Collection	**$2,297,100**	**$2,047,600**	**$3,619,850**	**$3,032,870**	**$3,980,560**
2. Minimum Service:					
Residential Drop-off Depots (3%)	$2,147,510	$1,522,310	$3,105,750	$2,832,630	$3,077,150
ICI Self-delivery (5%)	$255,750	$204,910	$359,250	$278,530	$490,460
Total Minimum Service Collection	**$2,403,260**	**$1,727,220**	**$3,465,000**	**$3,111,160**	**$3,567,610**
3. MaxRF (wet-Dry) Service:					
Residential Roadside Collection (100%)	$3,437,650	$2,568,630	$4,817,440	$3,754,090	$6,038,810
ICI Pick-up/Self-delivery (100%)	$1,781,450	$1,788,270	$3,582,160	$2,641,230	$4,740,980
Total MaxRF Service Collection	**$5,219,100**	**$4,356,900**	**$8,399,600**	**$6,395,320**	**$10,779,790**

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(1) Direct comparisons between MaxRF and the other BASE CASE recycling systems are not valid without consideration of the costs of collecting all wastes. See section 5.4 for cost comparisons of the Base Case systems on an equai basis

(2) Bracketed percentages indicate the proportions of the total waste stream collected by the recycling collection system.

Table 5.13
Base Case Recycling Systems Revenues

Base Case	Recyclables Materials Revenues				
Recycling Systems(1)	CPFSA1	CPFSA2	CPFSA3	CPFSA4	CPFSA5
1. Full Service:					
Residential Roadside Collection (15%)	$225,628	$322,712	$560,248	$356,772	$404,144
ICI Pick-up Service (25%)	$378,720	$614,016	$1,280,952	$973,800	$1,016,712
Total Full Service Revenue	**$604,348**	**$936,728**	**$1,841,200**	**$1,330,572**	**$1,420,856**
2. Minimum Service:					
Residential Drop-off Depots (3%)	$45,136	$64,532	$112,060	$71,344	$80,808
ICI Self-delivery (5%)	$75,744	$122,832	$256,176	$194,760	$203,328
Total Minimum Service Revenue	**$120,880**	**$187,364**	**$368,236**	**$266,104**	**$284,136**
3. MaxRF (Wet-Dry) Service:					
Residential Roadside Collection (60%)	$646,137	$924,208	$1,604,457	$1,021,808	$1,157,507
ICI Pick-up Service (66%)	$571,287	$926,110	$1,932,042	$1,468,803	$1,533,468
Total MaxRF Service Revenue	**$1,217,424**	**$1,850,318**	**$3,536,499**	**$2,490,611**	**$2,690,975**

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(1) Bracketed percentages indicate the diversion rates of the recycling systems.

Table 5.14
Summary of Central Processing Facility Service Area Costs and Revenues - CPFSA #1

Base Recycling System(1):	A. Full Service	B. Minimum Service	C. MaxRF (Wet/Dry)(2)
Residential Component:	Roadside Collection (15%)	Drop-off Depot (3%)	Roadside Collection (60%)
ICI Component:	Pick-up Service (25%)	Self-Delivery (5%)	Pick-Up/Self-Delivery (66%)
Annual Costs and Revenues			
Processing Costs:	$916,240	$410,058	$3,011,181
Residential Collection Costs:	$1,510,590	$2,147,510	$3,437,650
ICI Collection Costs:	$786,510	$255,750	$1,781,450
Total System Costs:	$3,213,340	$2,813,318	$8,230,281
Total System Cost per Tonne(3): (of Recyclables)	$335	$1,465	$263
Total Revenues:	$604,348	$120,880	$1,217,424
Total Net System Cost:	$2,608,992	$2,692,438	$7,012,857
Total Net System Cost per Tonne: (of Recyclables)	$272	$1,402	$224
Total Net System Cost per Tonne: (of Recyclables excluding ICI collection costs)	$190	$1,269	$167
Total Net System Cost per Tonne of All Wastes: (excluding ICI collection costs)	$36	$49	$105
Total Net System Cost per Household of All Wastes: (excluding ICI collection costs)	$58	$77	$166

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(1) Bracketed percentages indicate diversion rates of the Base Case recycling systems.

(2) Direct Comparisons of MaxRF with the other recycling systems are not valid without consideration of all costs. See Section 5.4 for cost comparison of recycling systems on an equal basis.

(3) Recyclables tonnage are provided in Table 5.10 per CPFSA.

(4) Total solid wastes tonnage generated per CPFSA are provided in Table 5.1.

Table 5.15
Summary of Central Processing Facility Service Area Costs and Revenues - CPFSA #2

Base Recycling System(1):	A. **Full Service**	B. **Minimum Service**	C. **MaxRF (Wet/Dry)(2)**
Residential Component:	**Roadside Collection (15%)**	**Drop-off Depot (3%)**	**Roadside Collection (60%)**
ICI Component:	**Pick-up Service (25%)**	**Self-Delivery (5%)**	**Pick-Up/Self-Delivery (66%)**
Annual Costs and Revenues			
Processing Costs:	$965,170	$486,463	$3,296,723
Residential Collection Costs:	$1,256,730	$1,522,310	$2,568,630
ICI Collection Costs:	$790,870	$204,910	$1,788,270
Total System Costs:	$3,012,770	$2,213,683	$7,653,623
Total System Cost per Tonne(3): (of Recyclables)	$204	$751	$161
Total Revenues:	$936,728	$187,364	$1,850,318
Total Net System Cost:	$2,076,042	$2,026,319	$5,803,305
Total Net System Cost per Tonne: (of Recyclables)	$141	$688	$123
Total Net System Cost per Tonne: (of Recyclables excluding ICI collection costs)	$87	$618	$85
Total Net System Cost per Tonne of All Wastes: (excluding ICI collection costs)	$17	$24	$53
Total Net System Cost per Household of All Wastes: (excluding ICI collection costs)	$37	$52	$115

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(1) Bracketed percentages indicate diversion rates of the Base Case recycling systems.

(2) Direct Comparisons of MaxRF with the other recycling systems are not valid without consideration of all costs. See Section 5.4 for cost comparison of recycling systems on an equal basis.

(3) Recyclables tonnage are provided in Table 5.10 per CPFSA.

(4) Total solid wastes tonnage generated per CPFSA are provided in Table 5.1.

Table 5.16
Summary of Central Processing Facility Service Area Costs and Revenues - CPFSA #3

Base Recycling System(1):	A. Full Service	B. Minimum Service	C. MaxRF (Wet/Dry)(2)
Residential Component:	Roadside Collection (15%)	Drop-off Depot (3%)	Roadside Collection (60%)
ICI Component:	Pick-up Service (25%)	Self-Delivery (5%)	Pick-Up/Self-Delivery (66%)
Annual Costs and Revenues			
Processing Costs:	$1,252,967	$503,533	$6,895,432
Residential Collection Costs:	$2,231,210	$3,105,750	$4,817,440
ICI Collection Costs:	$1,388,640	$359,250	$3,582,160
Total System Costs:	$4,872,817	$3,968,533	$15,295,032
Total System Cost per Tonne(3): (of Recyclables)	$171	$695	$169
Total Revenues:	$1,841,200	$368,236	$3,536,499
Total Net System Cost:	$3,031,617	$3,600,297	$11,758,533
Total Net System Cost per Tonne: (of Recyclables)	$106	$630	$131
Total Net System Cost per Tonne: (of Recyclables excluding ICI collection costs)	$58	$567	$91
Total Net System Cost per Tonne of All Wastes: (excluding ICI collection costs)	$11	$23	$57
Total Net System Cost per Household of All Wastes: (excluding ICI collection costs)	$26	$52	$131

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(1) Bracketed percentages indicate diversion rates of the Base Case recycling systems.

(2) Direct Comparisons of MaxRF with the other recycling systems are not valid without consideration of all costs. See Section 5.4 for cost comparison of recycling systems on an equal basis.

(3) Recyclables tonnage are provided in Table 5.10 per CPFSA.

(4) Total solid wastes tonnage generated per CPFSA are provided in Table 5.1.

Table 5.17
Summary of Central Processing Facility Service Area Costs and Revenues - CPFSA #4

Base Recycling System(1):	A. Full Service	B. Minimum Service	C. MaxRF (Wet/Dry)(2)
Residential Component:	Roadside Collection (15%)	Drop-off Depot (3%)	Roadside Collection (60%)
ICI Component:	Pick-up Service (25%)	Self-Delivery (5%)	Pick-Up/Self-Delivery (66%)
Annual Costs and Revenues			
Processing Costs:	$1,036,064	$486,463	$4,378,065
Residential Collection Costs:	$1,939,630	$2,832,630	$3,754,090
ICI Collection Costs:	$1,093,240	$278,530	$2,641,230
Total System Costs:	$4,068,934	$3,597,623	$10,773,385
Total System Cost per Tonne(3): (of Recyclables)	$200	$882	$170
Total Revenues:	$1,330,572	$266,104	$2,490,611
Total Net System Cost:	$2,738,362	$3,331,519	$8,282,774
Total Net System Cost per Tonne: (of Recyclables)	$134	$817	$131
Total Net System Cost per Tonne: (of Recyclables excluding ICI collection costs)	$81	$749	$89
Total Net System Cost per Tonne of All Wastes: (excluding ICI collection costs)	$16	$31	$57
Total Net System Cost per Household of All Wastes: (excluding ICI collection costs)	$28	$52	$95

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(1) Bracketed percentages indicate diversion rates of the Base Case recycling systems.

(2) Direct Comparisons of MaxRF with the other recycling systems are not valid without consideration of all costs. See Section 5.4 for cost comparison of recycling systems on an equal basis.

(3) Recyclables tonnage are provided in Table 5.10 per CPFSA.

(4) Total solid wastes tonnage generated per CPFSA are provided in Table 5.1.

Table 5.18
Summary of Central Processing Facility Service Area Costs and Revenues - CPFSA #5

Base Recycling System(1):	A. Full Service	B. Minimum Service	C. MaxRF (Wet/Dry)(2)
Residential Component:	Roadside Collection (15%)	Drop-off Depot (3%)	Roadside Collection (60%)
ICI Component:	Pick-up Service (25%)	Self-Delivery (5%)	Pick-Up/Self-Delivery (66%)
Annual Costs and Revenues			
Processing Costs:	$1,053,029	$486,463	$6,675,946
Residential Collection Costs:	$2,493,580	$3,077,150	$6,038,810
ICI Collection Costs:	$1,486,980	$490,460	$4,740,980
Total System Costs:	$5,033,589	$4,054,073	$17,455,736
Total System Cost per Tonne(3): (of Recyclables)	$230	$926	$255
Total Revenues:	$1,420,856	$284,136	$2,690,975
Total Net System Cost:	$3,612,733	$3,769,937	$14,764,761
Total Net System Cost per Tonne: (of Recyclables)	$165	$861	$216
Total Net System Cost per Tonne: (of Recyclables excluding ICI collection costs)	$97	$749	$147
Total Net System Cost per Tonne of All Wastes: (excluding ICI collection costs)	$20	$30	$93
Total Net System Cost per Household of All Wastes: (excluding ICI collection costs)	$38	$59	$180

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(1) Bracketed percentages indicate diversion rates of the Base Case recycling systems.

(2) Direct Comparisons of MaxRF with the other recycling systems are not valid without consideration of all costs. See Section 5.4 for cost comparison of recycling systems on an equal basis.

(3) Recyclables tonnage are provided in Table 5.10 per CPFSA.

(4) Total solid wastes tonnage generated per CPFSA are provided in Table 5.1.

collection of recyclables; the collection costs of the remaining solid wastes are not accounted for. Therefore to ensure all three of the Base Case recycling systems are compared on an equal basis, all costs of waste management operations must be included in the bottom - line comparison. This will be done in **Section 5.4**.

Following are brief descriptions of each cost and revenue component included in **Tables 5.14** to **5.18**. **Tables C.1** to **C.5** of **Appendix C** provide more detailed breakdowns of the Base Case Recycling Systems costs and revenues applicable to the five CPFSA's.

Processing Costs: the annual amortized capital and annual operating costs of the CPF and MaxRF recyclables processing plants. (see **Table 5.11** for processing plant cost components of the Base Case recycling systems per CPFSA).

Residential Collection Costs: the annual costs of collection and delivery of source separated residential recyclables to the CPF's and of all separated wet and dry wastes to the MaxRF. (see **Table 5.12** for Total Collection Costs per CPFSA of the Base Case recycling systems).

ICI Collection Costs: the annual costs of pick-up and/or delivery of source separated ICI recyclables to the CPF's and of all separated wet and dry ICI wastes to the MaxRF.

Total System Costs: the sum of total annual Processing Costs and total annual Residential and ICI Collection Costs.

Total System Cost per Tonne (of Recyclables): the Total System Costs per annum divided by the annual tonnes of recyclables diverted by the Base Case total Residential and ICI recycling systems. (See **Table 5.10** for recycling systems diversion tonnages per CPFSA).

Total Revenues: the annual sum of the revenue received for all diverted recyclable materials processed at the CPF and MaxRF plants. (See **Table 5.13** for the breakdown of the Base Case Residential and ICI recycling systems revenues per CPFSA).

Total Net System Cost: the annual Total System Costs less the Total Revenues received per Base Case recycling system.

Total Net System Cost per Tonne (of Recyclables): the annual Total Net System Cost (ie. including revenue) divided by the annual tonnes of recyclables diverted by the Base Case total Residential and ICI recycling systems. (see **Table 5.10** for the recycling systems diversion tonnages per CPFSA).

Total Net System Cost per Tonne (of Recyclables excluding ICI collection costs):

The annual ICI collection costs are subtracted from the annual total Net System Costs, which are then divided by the annual tonnes of recyclables diverted by the Base Case total Residential and ICI recycling systems. (See **Table 5.10** for recycling systems diversion tonnages per CPFSA).

Total Net System Cost per Tonne of All Waste (Excluding ICI Collection Costs): the annual ICI Collection Costs are subtracted from the annual Total Net System Costs, which are then divided by the Total All Waste generated per CPFSA. (See **Table 5.1** for the Total All Waste tonnages generated per CPFSA).

Total Net System Cost per Household of All Waste (Excluding ICI Collection Costs): the annual ICI Collection Costs are subtracted from the annual Total Net System Costs, which are then divided by the Total Households per CPFSA. (See **Table 5.1** for the Total Households per CPFSA).

These above data will be utilized in **Section 5.4** to assess to total waste management system costs, which incorporates the Base Case recycling system options costs in with the collection, transportation and disposal of non-recycled wastes.

5.3 Sensitivity Tests Analysis

This section provides the results of the Sensitivity Tests analysis of several variations to the typical or average parameter values applied to Base Case recycling systems. The Sensitivity Tests analysis permits evaluation of alternate recycling systems vehicle options, service levels, diversion rates, materials recycled and recyclables prices for comparison to the respective Base Case recycling systems.

Summary tables will be provided throughout this section to indicate the impact on sensitivity of the parameter variations relative to the Base Case recycling systems. In addition, detailed tables of the complete series of Sensitivity Tests are provided in **Appendix C** to be referred to as directed.

5.3.1 Sensitivity Tests of Residential Roadside Collection Recycling Systems

The Full Service recycling system is composed of residential roadside collection and ICI pick-up service. This section focuses on the residential roadside collection cost component. The results of the Sensitivity Tests by category are presented below.

5.3.1.1 Alternative Collection Vehicles

Table 5.19 presents the summary cost comparison of alternate residential roadside collection vehicles to those selected for the Base Case on an annual residential collection cost basis. **Table 5.20** presents the annual residential roadside collection costs of the Base Case recycling system vehicles and other vehicle options on a per tonne basis of diverted recyclable materials.

Detailed Base Case and Sensitivity Test tables of the residential roadside collection vehicle options are provided in **Appendix C - Tables C1** to **C3** and **C6** to **C10**.

In general the residential recycling collection vehicle costs do not vary widely. One-person operated vehicles (SDRV-PL, SDRV-ML and Packer SL) proved to be somewhat less costly than the two or three person operated vehicles (Cube Van, 1/2 Ton/Trailer, Packer/Trailer and Packer (RL). The Packer/Trailer vehicle system costs are much higher per tonne of recyclables collected, but the system also collects other non-recyclable residential solid wastes.

5.3.1.2 Service Level Variations

Table 5.21 presents a cost comparison of the Base Case Blue Box SDRV-PL residential recycling system collection with variations in service frequency and extent of services. Provision of residential blue-box recycling collection services on a bi-weekly and monthly basis will reduce diversion rates to 13.2% and 12.2%, respectively, as compared with the 15% diversion realized by the weekly Base Case service.

Table 5.19

Residential Roadside Collection Recycling System Vehicle Options Costs

Residential Roadside Collection		Annual Residential Collection Costs(1)				
System	Vehicle	CPFSA1	CPFSA2	CPFSA3	CPFSA4	CPFSA5
Blue Box:	**SDRV-PL**	$1,510,590	$1,256,730	$2,231,210	$1,939,630	$2,493,580
	SDRV-ML	$1,485,670	$1,227,760	$2,198,840	$1,894,300	$2,531,770
	Cube Van	$1,826,890	$1,543,430	$2,754,040	$2,237,170	$3,206,780
	½ Ton/Trailer	$1,867,560	$1,499,670	$2,697,370	$2,298,460	$3,215,820
	Packer/Trailer(2)	$3,927,970	$3,431,240	$5,969,130	$5,218,680	$6,639,780
Stackable Bins:	**SDRV-PL**	$1,607,810	$1,256,730	$2,423,690	$2,122,570	$2,665,560
Blue Bag:	**Packer-SL**	$1,449,900	$1,179,690	$2,108,730	$1,804,660	$2,382,483
	Packer-RL	$1,709,297	$1,387,630	$2,475,480	$2,113,760	$2,791,415

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1. Collection costs of Roadside Collection Systems - ie. Blue Box, Stackable Bins, and Blue Bag - are based on 15% diversion rate.

2. Packers with trailers recyclables collection cost include solid waste co-collection.

3. Detailed Base Case and Sensitivity Test tables of the residential roadside collection vehicles are provided in Appendix C - Tables C1 to C3 and C6 to C10.

Table 5.20

Residential Recyclables Collection System Options Costs per Tonne of Residential Recyclables

Residential Roadside Collection		Annual Collection Costs per Tonne of Residential Recyclables(1)				
System	Vehicle	*CPFSA1*	*CPFSA2*	*CPFSA3*	*CPFSA4*	*CPFSA5*
Blue Box:	**SDRV-PL**	$348	$202	$207	$283	$321
	SDRV-ML	$342	$198	$204	$276	$326
	Cube Van	$421	$249	$256	$326	$413
	½ Ton/Trailer	$430	$242	$250	$335	$414
	Packer/Trailer(2)	$905	$553	$554	$761	$854
Stackable Bins:	**SDRV-PL**	$371	$202	$225	$309	$343
Blue Bag:	**Packer-SL**	$334	$190	$196	$263	$307
	Packer-RL	$394	$224	$230	$308	$359

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1. Collection costs of Roadside Collection Systems - ie. Blue Box, Stackable Bins, and Blue Bag - are based on 15% diversion rate.

2. Packers with trailers recyclables collection cost include solid waste co-collection.

3. Detailed Base Case and Sensitivity Test tables of the residential roadside collection vehicles are provided in Appendix C - Tables C1 to C3 and C6 to C10.

Table 5.21

Residential Recyclables Roadside Collection Costs of Varied Service Frequency and Extent of Service

Residential Collection Service Provided(1)	Annual Residential Collection Costs CPFSA1	CPFSA2	CPFSA3	CPFSA4	CPFSA5
Base Case - Weekly (15%)	$1,510,590	$1,256,730	$2,231,210	$1,939,630	$2,493,580
Bi-Weekly (13.2%)	$1,222,830	$1,069,760	$1,909,720	$1,689,030	$2,096,310
Monthly (12.2%)	$1,083,460	$991,160	$1,723,280	$1,519,500	$1,882,660
Urban Areas Only-Weekly (15%)(2)	$280,210	$573,940	$1,039,170	$402,010	$536,990
Urban Collection-Weekly (15%)(2) with Rural Drop-off Depots (3%)	$2,065,990	$1,373,130	$2,738,040	$2,466,910	$3,044,060

---

1. Bracketed percentages are the diversion rates of the collection services provided.

2. Actual recyclable materials diversion volumes will be reduced per CPFSA due to the elimination or reduction of services provided to rural areas- in the urban only, and urban collection with rural depots systems, respectively.

3. Detailed Base Case and Sensitivity Test tables of the variations in residential recyclable collection service frequency are provided in Appendix C - Tables C1 and C11 to C14.

Table 5.21 also presents the costs of providing weekly residential roadside collection recycling systems in urban areas only, as well as the option of providing roadside collection service in urban areas, supplemented by drop-off depots in the remaining rural areas. While the weekly urban roadside collection recycling services would retain a 15% diversion rate, the overall diversion of recyclable materials from the residential waste streams per CPFSA would be reduced in accordance with the absent or diminished services provided in the rural areas. In fact overall regionwide diversion rates for the five CPFSA's from the reduced residential collection services are as follows:

	Regionwide Residential Diversion Rate	
	Urban Roadside Collection Only	Urban Collection/ Rural Depots
CPFSA1:	4.4%	6.5%
CPFSA2:	9.1%	10.3%
CPFSA3:	10.8%	11.6%
CPFSA4:	7.5%	9.0%
CPFSA5:	3.6%	5.9%

Table 5.22 provides the annual collection costs per tonne of residential recyclables per CPFSA for the Base Case Blue Box SDRV-PL recycling system and the variations in service frequency and extent of services. In general these reduced collection service approaches do reduce collection costs, but also reduce diversion levels.

Detailed Base Case and Sensitivity Test tables of the variations in service frequency and extent of services provided are presented in **Appendix C - Tables** C1 and C11 to C14.

5.3.1.3 Variations in Diversion Rates

Variations in residential recyclables diversion rates will affect annual roadside collection costs, and are particularly obvious for the collection costs per tonne. **Table** 5.23 presents the Base Case Blue Box SDRV-PL residential recycling system and collection costs along with High (25%) and Low (10%) diversion rates per CPFSA. The per tonne residential recyclables collection costs are also provided in **Table** 5.23. In general residential roadside collections cost do not vary in proportion to the volume of recyclable materials diverted, high or low, by a given system. The per tonne collection costs vary more according to the altered

Table 5.22

Residential Recyclables Roadside Collection Costs per Tonne of Varied Service Frequency and Extent of Service

Residential Collection Service Provided(1)	Annual Residential Collection Costs per Tonne				
	CPFSA1	*CPFSA2*	*CPFSA3*	*CPFSA4*	*CPFSA5*
Base Case - Weekly (15%)	$348	$202	$207	$283	$321
Bi-Weekly (13.2%)	$320	$196	$201	$280	$306
Monthly (12.2%)	$307	$196	$197	$272	$298
Urban Areas Only-Weekly (15%)(2)	$221	$152	$135	$117	$287
Urban Collection-Weekly (15%)(2) with Rural Drop-off Depots (3%)	$1,098	$322	$329	$599	$997

---

1. Bracketed percentages are the diversion rates of the collection services provided.

2. Actual recyclable materials diversion volumes will be reduced per CPFSA due to the elimination or reduction of services provide to rural areas- in the urban only, and urban collection with rural depots systems, respectively.

3. Detailed Base Case and Sensitivity Test tables of the variations in residential recyclable collection service frequency are provided in Appendix C - Tables C1 and C11 to C14.

Table 5.23

Residential Roadside Collection Costs of Varied Recyclables Diversion Rates

Residential Roadside	Annual Roadside Collection Costs				
Collection Diversion Rates	*CPFSA1*	*CPFSA2*	*CPFSA3*	*CPFSA4*	*CPFSA5*
Base Case (15%)					
Total:	$1,510,590	$1,256,730	$2,231,210	$1,939,630	$2,493,580
per Tonne:	$348	$202	$207	$283	$321
High Diversion (25%)					
Total:	$1,659,060	$1,377,060	$2,381,960	$2,060,390	$2,817,020
per Tonne:	$229	$133	$133	$180	$217
Low Diversion (10%)					
Total:	$1,433,350	$1,244,810	$2,193,330	$1,909,020	$2,372,160
per Tonne:	$496	$301	$305	$417	$458

---

1. Detailed Base Case and Sensitivity Test tables of the variatins in residential roadside collection recyclables diversion rates are provided in Appendix C- Tables C1 and C15 to C17.

diversion rates than the marginal affects of the total costs of collection. This highlites an obvious economies incentive to improve the diversion rates of recycling programs.

Detailed Base Case and Sensitivity Test tables of the variations in diversion rates, High (25%) and Low (10%), for residential roadside collection systems are provided in **Appendix C - Tables** **C1** and **C15** to **C17**.

5.3.1.4 Variations in Recyclable Materials Collected

Annual collection costs will be affected by variations in the recyclable materials collected in a roadside collection system. **Table 5.6** of **Section 5.1.2** of this chapter provided the Base Case roadside collection system recyclable materials collected and three alternate groups of recyclable materials with their respective diversion rates. **Table 5.24** presents the annual total and per tonne residential roadside collection costs per CPFSA of the Base Case and the three groups of variations of recyclable materials collected.

Adding or removing recyclable materials from the Base Case set, as in the cases of Group 1 and Group 3, respectively, only marginally affects collection costs of a given recycling system. However, to provide a special Spring/Fall bulky recyclables collection service, as in Group 2, with a parallel collection operation will add proportionally to the overall collection costs.

Detailed Base Case and Sensitivity Test tables of the variations in residential recyclable materials collected are presented in **Appendix C - Tables** **C1** and **C18** to **C21**.

5.3.2 Sensitivity Tests of Residential Drop-off Depots Recycling Systems

The Minimum Service recycling system is comprised of residential drop-off depots collection system and ICI self-delivery service. This section focuses on the residential drop-off depot collection cost component. The results of the Sensitivity Tests by category are presented below.

Table 5.24

Residential Roadside Collection Costs of Variations in Recyclable Materials Collected

Recyclable Materials Collected - Diversion	Annual Residential Roadside Collection Costs				
	CPFSA1	*CPFSA2*	*CPFSA3*	*CPFSA4*	*CPFSA5*
Base Case Materials (15%) (newspaper, clear glass, aluminum cans and PET, HDPE and film plastics)					
Total:	$1,510,590	$1,256,730	$2,231,210	$1,939,630	$2,493,580
per Tonne:	$348	$202	$207	$283	$321
Group 1 Materials (21%) (Base Case materials plus tin cans, coloured glass, cardboard and boxboard)					
Total:	$1,585,690	$1,321,590	$2,334,880	$2,008,100	$2,689,600
per Tonne:	$261	$152	$155	$209	$247
Group 2 Materials (18%) (Base Case materials plus white goods, wood and other metals)					
Total:	$1,864,260	$1,550,630	$2,874,706	$2,365,040	$3,114,230
per Tonne:	$358	$208	$222	$287	$334
Group 3 Materials (13.2%) (Base Case materials less clear glass, PET and aluminum beverage containers)					
Total:	$1,506,200	$1,253,610	$2,228,900	$1,932,830	$2,476,270
per Tonne:	$394	$230	$235	$320	$362

---

1. Detailed Base Case and Sensitivity Test tables of the variatins in recyclable materials collected are provided in Appendix C- Tables C1 and C18 to C21.

5.3.2.1 Variations in Diversion Rates

Variations in residential recyclables diversion will have only a very marginal affect on the drop-off depots system collection costs. However, the costs per tonne of the drop-off depots vary significantly in accordance with the high (5%) or low (2%) diversion of recyclable materials. **Table 5.25** provides the annual total and per tonne residential drop-off depot recycling system collection costs of the five CPFSA's.

Detailed Base Case and Sensitivity Test tables of the variations in residential recyclables diversion rates, High (5%) and Low (2%), for the drop-off depots recycling systems are provided in **Appendix C - Tables C4, C22** and **C23**.

5.3.2.2 Variations in Recyclable Materials Collected

Variations by adding or removing recyclable materials from the Base Case set will impact drop-off depots total collection system costs only marginally, but will be more prominent on a per tonne basis. However, this is more the effect of the changes in recyclables diversion than the operations costs of the drop-off depots. **Table 5.6** of **Section 5.1.2** of this chapter provided the Base Case drop-off depots system recyclable materials collected and three alternate recyclable materials groups with their respective diversion rates.

Table 5.26 presents the annual total and per tonne costs of residential drop-off depots system collection per CPFSA of the Base Case and the three alternate recyclable materials groups. The Group 2 materials involve the provision of a special spring/fall drop-off and pick-up service of bulky recyclable materials, and therefore has a greater impact on total collection costs.

Detailed Base Case and Sensitivity Test tables of the variation in residential recyclable materials collected are provided in **Appendix C - Tables C4** and **C24** to **C26**.

5.3.3 Sensitivity Tests of Residential MaxRF Collection Systems

The MaxRF Service recycling system is composed of residential roadside collection and a combination of ICI pick-up and self-delivery service. This section focuses on

Table 5.25

Residential Drop-off Depots System Collection Costs of Varied Recyclables Diversion Rates

Residential Drop-off Depots Diversion Rates	Annual Drop-off Depots Collection Costs CPFSA1	CPFSA2	CPFSA3	CPFSA4	CPFSA5
Base Case (3%)					
Total:	$2,147,510	$1,522,310	$3,105,750	$2,832,630	$3,077,150
per Tonne:	$2,475	$1,226	$1,441	$2,064	$1,979
High Diversion (5%)					
Total:	$2,243,530	$1,542,930	$3,139,380	$2,856,250	$3,194,130
per Tonne:	$1,551	$746	$874	$1,249	$1,233
Low Diversion (2%)					
Total:	$2,110,930	$1,514,720	$3,086,010	$2,828,440	$3,061,800
per Tonne:	$3,649	$1,831	$2,148	$3,092	$2,954

---

1. Detailed Base Case and Sensitivity Test tables of the variations in residential drop-off depots collection system recyclables diversion rates are provided in Appendix C- Tables C4, C22 and C23.

Table 5.26

Residential Drop-off Depots System Collection Costs of Variations in Recyclable Materials Collected

Residential Recyclable Materials Collected - Diversion	Annual Drop-off Depots Collection Costs				
	CPFSA1	*CPFSA2*	*CPFSA3*	*CPFSA4*	*CPFSA5*
Base Case Materials (3%) **(newspaper, clear glass, aluminum cans and PET, HDPE and film plastics)**					
Total:	$2,147,510	$1,522,310	$3,105,750	$2,832,630	$3,077,150
per Tonne:	$2,475	$1,226	$1,441	$2,064	$1,979
Group 1 Materials (4.2%) **(Base Case materials plus tin cans, coloured glass, cardboard and boxboard)**					
Total:	$2,231,410	$1,534,620	$3,126,130	$2,844,210	$3,109,954
per Tonne:	$1,837	$883	$1,036	$1,480	$1,429
Group 2 Materials (3.6%) **(Base Case materials plus white goods, wood and other metals)**					
Total:	$2,305,350	$1,643,810	$3,371,090	$3,091,050	$3,345,880
per Tonne:	$2,214	$1,104	$1,304	$1,877	$1,794
Group 3 Materials (2.64%) **(Base Case materials less clear glass, PET and aluminum beverage containers)**					
Total:	$2,130,650	$1,520,170	$3,102,460	$2,831,230	$3,072,470
per Tonne:	$2,790	$1,392	$1,636	$2,344	$2,246

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1. Detailed Base Case and Sensitivity Test tables of the variations in recyclable materials collected are provided in Appendix C- Tables C4 and C24 to C26.

the residential roadside MaxRF collection of all source-separated wet and dry residential wastes.

Table 5.27 presents the annual total per tonne residential collection costs of alternate MaxRF roadside collection vehicle systems. Although all residential wastes are collected, only 60% of the wastes are actually diverted from the waste stream for dry recyclables and wet compost materials. The collection costs are for co-collected colour-coded bags of the separated wet and dry materials collected in a low-compression Packer SL vehicle. In one system wet and dry waste bags are co-collected in one vehicle, and in the other system the wet and dry bags are collected in separate vehicles. Costs are considerably higher for the system which provides separate collection of wet and dry bags by two packer SL's, or by one Packer SL collecting all dry bags on one circuit and a wet bags on another round.

Detailed Base Case and Sensitivity Test tables of the alternative residential MaxRF roadside collection systems are provided in **Appendix C - Tables** C5, C27 and C28.

5.3.4 Sensitivity Tests of ICI Collection Systems

The Base Case ICI pick-up service and self-delivery recyclables collection approaches divert 25% and 5% of ICI waste stream, respectively. Variations in ICI recyclables diversion rates have been tested to determine their impact on collection costs. These variations in diversion include high and low diversion rates scenarios, additional recyclable materials to the Base Case set, and extent of service.

Table 5.28 presents the annual total ICI collection costs of the various recyclables diversion levels. **Table** 5.29 presents the annual ICI collection costs per tonne of the varied diversion levels. The Base Case ICI recyclable materials include cardboard and ledger, computer print-out, coloured and mixed papers. Additional ICI recyclable materials collected include the Base Case set plus clear glass, aluminum cans, mixed plastics, wood and tires.

Detailed Base Case and Sensitivity Test tables of the various ICI pick-up service and self-delivery diversion levels are provided in **Appendix C - Tables** C1, C4, C13, to C16, C18, C20, C22 and C23.

Table 5.27

Residential MaxRF Roadside Collection Alternate System Costs

MaxRF Roadside Collection Systems(1)	Annual Residential Collection Costs				
	CPFSA1	*CPFSA2*	*CPFSA3*	*CPFSA4*	*CPFSA5*
Base Case -SDRV (2 compartment)					
Total:	$3,437,650	$2,568,630	$4,817,440	$3,754,090	$6,038,810
per Tonne:	$198	$103	$112	$137	$194
Packer - SL (Co-collection)					
Total:	$3,146,110	$2,266,420	$4,318,120	$3,336,650	$5,493,610
per Tonne:	$181	$91	$100	$122	$177
Packer - SL (Separate Wet/Dry Collection)					
Total:	$5,332,248	$4,184,450	$7,644,820	$6,327,320	$9,071,380
per Tonne:	$307	$169	$177	$231	$292

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1. Actual diversion of MaxRF systems of dry recyclable and wet compost materials from the total residential waste stream is 60%, although all residential wastes are collected in MaxRF collection systems.

2. Detailed Base Case and Sensitivity Test tables of MaxRF roadside collection systems are provided in Appendix C- Tables C5, C27 and C28.

Table 5.28

Industrial-Commercial-Institutional (ICI) Collection Costs per Diversion Level

ICI Collection System	Total Annual ICI Collection Costs				
Diversion Scenario	*CPFSA1*	*CPFSA2*	*CPFSA3*	*CPFSA4*	*CPFSA5*
ICI Pick-up Service:					
Base - 25%	$786,510	$790,870	$1,388,640	$1,093,240	$1,486,980
High - 35%	$912,960	$966,450	$1,769,070	$1,380,240	$1,902,890
Low - 10%	$594,210	$545,900	$856,760	$702,380	$914,680
Additional RM's - 39.15%	$987,910	$1,044,370	$1,953,320	$1,515,640	$2,074,240
Urban Only - 25%	$149,340	$299,930	$722,650	$346,600	$354,540
ICI Self-Delivery:					
Base - 5%	$255,750	$204,910	$359,250	$278,530	$490,460
High - 20%	$562,910	$462,020	$810,020	$680,970	$1,205,010
Low - 0%	$0	$0	$0	$0	$0
Additional RM's - 7.83%	$310,090	$261,400	$443,560	$350,390	$576,720
Urban P-U/Rural S-D: 25% / 5%	$360,920	$443,490	$948,580	$571,020	$736,150

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1. Detailed Base Case and Sensitivity Test tables of the various ICI pick-up service and self-delivery diversion levels are provided in Appendix C - Tables C1, C4, C13 to C16, C18, C20, C22 and C23.

Table 5.29

Industrial-Commercial-Institutional (ICI) Collection Costs per Diversion Level

ICI Collection System	Annual ICI Collection Costs per Tonne of Recyclables				
Diversion Scenario	*CPFSA1*	*CPFSA2*	*CPFSA3*	*CPFSA4*	*CPFSA5*
ICI Pick-up Service:					
Base - 25%	$150	$93	$78	$81	$105
High - 35%	$124	$81	$71	$73	$96
Low - 10%	$282	$160	$120	$130	$162
Additional RM's - 39.15%	$120	$78	$70	$72	$94
Urban Only - 25%	$99	$58	$53	$48	$87
ICI Self-Delivery:					
Base - 5%	$243	$120	$101	$103	$174
High - 20%	$134	$68	$57	$63	$107
Low - 0%	$0	$0	$0	$0	$0
Additional RM's - 7.83%	$188	$98	$80	$83	$130
Urban P-U/Rural S-D: 25% / 5%	$401	$374	$430	$289	$305

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1. Detailed Base Case and Sensitivity Test tables of the various ICI pick-up service and self-delivery diversion levels are provided in Appendix C - Tables C1, C4, C13 to C16, C18, C20, C22 and C23.

5.3.5 Sensitivity Tests of Recyclable Materials Revenue

The Base Case recycling system revenues were provided in **Table** 5.13 of **Section** 5.2.5. **Table** 5.30 presents the revenues received per CPFSA under high (+20%) and low (-20%) price scenarios of residential recyclable materials for the Full Service residential roadside collection, Minimum Service residential drop-off depots and MaxRF Service residential roadside collection systems. Compost material revenues are $200 per tonne for the high price scenario and $0 for the low price scenario.

Table 5.31 presents the revenues received per CPFSA for the same high and low price scenarios for the Full Service ICI pick-up service, Minimum Service ICI self-delivery and MaxRF Service ICI pick-up service and self-delivery.

Detailed Base Case and Sensitivity Tests tables of the revenues from the various residential and ICI recyclable materials price scenarios are provided in **Appendix C - Tables** C1, C4, C5 and C29 to C34.

5.4 Summary Comparative Analysis of Recycling Systems

In **Section** 5.2.5 the Base Case recycling systems costs and revenue information were summarized for each of the five CPFSA's in **Tables** 5.14 to 5.18. While these tables provide the summary of Base Case recycling systems financial information provided by this study, some essential cost information were not available to make valid comparisons of the Full Service (ie. residential roadside collection with ICI pick-up service) and Minimum Service (ie. residential drop-off depots with ICI self-delivery) recycling systems with the MaxRF Service (ie. residential roadside wet-dry materials collection with ICI wet-dry materials pick-up and self delivery) recycling systems on an equal basis.

The Full and Minimum Service recycling systems residential and ICI collection costs include only the collection of recyclable materials for delivery to the CPF's. These recycling systems require operation of a parallel recyclables collection service independent of the collection of the remaining non-recyclable solid wastes for delivery to a disposal site. In addition, relatively small amounts of residual non-recyclable wastes generated at the CPF's of about 5% of the recyclable materials, will require transport from the CPF to the disposal site.

Table 5.30

Residential Recyclable Materials Revenues per High and Low Price Scenarios

Residential Recyclable Materials Price Scenarios	Annual Recyclable Materials Revenues				
	CPFSA1	*CPFSA2*	*CPFSA3*	*CPFSA4*	*CPFSA5*
Full Service Roadside Collection					
Base Case Prices:	$225,628	$322,712	$560,248	$356,772	$404,144
High Prices:	$270,754	$387,254	$672,298	$428,126	$484,973
Low Prices:	$180,502	$258,170	$448,198	$285,418	$323,315
Minimum Service Drop-off Depots					
Base Case Prices:	$45,136	$64,532	$112,060	$71,344	$80,808
High Prices:	$54,163	$77,438	$134,472	$85,613	$96,970
Low Prices:	$36,109	$51,626	$89,648	$57,075	$64,646
MaxRF Service Roadside Collection					
Base Case Prices:	$646,137	$924,208	$1,604,457	$1,021,808	$1,157,507
High Prices:	$2,359,232	$3,374,551	$5,858,333	$3,730,913	$4,226,390
Low Prices:	$456,698	$653,243	$1,143,051	$722,227	$818,141

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1. Detailed Base Case and Sensitivity Test tables of the various residential recyclable materials price scenarios revenues are provided in Appendix C- Tables C1, C4, C5 and C29 and C34.

Table 5.31

ICI Recyclable Materials Revenues per High and Low Price Scenarios

	Annual Recyclable Materials Revenues				
ICI Recyclable Materials Price Scenarios	*CPFSA1*	*CPFSA2*	*CPFSA3*	*CPFSA4*	*CPFSA5*
Full Service Pick-up Service					
Base Case Prices:	$378,720	$614,016	$1,280,952	$973,800	$1,016,712
High Prices:	$454,464	$736,819	$1,537,142	$1,168,560	$1,220,054
Low Prices:	$302,976	$491,213	$1,024,762	$779,040	$813,370
Minimum Service Self Delivery					
Base Case Prices:	$75,744	$122,832	$256,176	$194,760	$203,328
High Prices:	$90,893	$147,398	$307,411	$233,712	$243,994
Low Prices:	$60,595	$98,266	$204,941	$155,808	$162,662
MaxRF Service Pick-up and Self Delivery					
Base Case Prices:	$571,287	$926,110	$1,932,042	$1,468,803	$1,533,468
High Prices:	$1,661,838	$2,693,995	$5,620,184	$4,272,651	$4,460,759
Low Prices:	$419,830	$680,583	$1,419,826	$1,079,399	$1,126,921

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1. Detailed Base Case and Sensitivity Test tables of the various ICI recyclable materials price scenarios revenues are provided in Appendix C- Tables C1, C4, C5 and C29 and C34.

The Base Case Full Service roadside collection recycling systems divert 15% of recyclable materials from the residential waste stream, so the remaining 85% of non-recycled solid wastes must be collected by the conventional solid waste collection system for disposal. Base Case Minimum Service drop-off depots recycling systems divert 3% of the recyclable materials from the residential waste stream, so the remaining 97% of non-recycled solid waste must be otherwise collected for disposal. Similarly ICI non-recyclable solid wastes would require separate delivery to a disposal site.

The MaxRF (wet-dry) Service recycling system residential and ICI collection is provided by an integrated collection system service, which delivers all wastes to the MaxRF plant. The MaxRF plant processes all materials and residual non-recyclable or compostable solid waste (ie. approximately 40% of the residential waste stream), which are transported on to a disposal site. Similarly, ICI wastes are collected, processed and transported on for disposal in one integrated system.

Three essential cost elements are missing from the Base Case recycling system per CPFSA **Tables** 5.14 to 5.18, which are required to make valid comparisons among the three alternate recycling systems. They are:

1. the non-recycled solid wastes (ie. garbage) collection costs required by the Full Service and Minimum Service recycling systems;

2. the transport costs of transferring process residuals and non-recyclable wastes from the CPF's or MaxRF's to a regional disposal site; and

3. the solid waste disposal costs of non-recycled solid wastes remaining from the three basic recycling system options.

These three cost elements are presently unknown to many of the Solid Waste Management Regions, principally due to the lack of a selected disposal method and/or site location. Some regions also have yet to establish their solid waste collection costs, while the estimated costs of solid waste collection of non-recycled solid waste required by the Full and Minimum Service recycling have not been estimated by most regions. In addition, most regions have not estimated costs of reduced waste disposal volumes resulting from portions of the waste stream diverted by the prospective recycling systems. For these reasons the Study Team were unable to provide a comprehensive comparison of the three basic recycling system options.

In light of the unavailability of the above essential cost elements, the need was expressed by the SWM Regional Managers for the Study Team to provide a guideline methodology and an applied example of the constituent cost elements necessary to enable SWM Regional Managers to:

1. estimate the missing recycling systems cost elements specific to their CPFSA and/or SWM Region;

2. provide a means to make valid "bottom line" cost comparisons among the three basic recycling systems on a equal basis;

3. assess the alternative recycling system options available (ie. as provided in the sensitivity analysis) to each basic recycling system; and

4. assess the costs of each of the three basic recycling systems in comparison with other solid waste management alternatives (therefore excluding the costs of ICI recyclables and solid waste collection of which the SWM Regions would not be responsible).

The Westmorland/Albert Solid Waste Management Region offered to make its cost information available for use as an example for this purpose. **Table 5.32** presents all the necessary summary information and cost elements to provide a regionally specific comparative assessment of the costs of the three recycling systems, as pertaining to the Westmorland/Albert region, a member region of CPFSA4. **Table 5.33** is a blank form of this summary comparison table for use by the SWM Regions. Following is a reference guide explaining all information and cost elements of the table on a line-by-line basis and identifying their source and/or estimation method.

Table 5.32
Comparison of Annual Costs of Recycling System Options(1)

	CPFSA	SWM Region
Number/Name:	4	*Westmorland / Albert*
Total Solid Waste (Tonnes):	*99,844*	*88,039*
Residential Solid Waste (Tonnes):	*45,743*	*38,737*
Total Households:	*59,205*	*48,580*

Recycling Systems:	Full Service	Minimum Service	MaxRF Service
Residential:	*Roadside Collection*	*Drop-off Depots*	*Roadside Collection*
ICI:	*Pick-up*	*Self-Delivery*	*Pick-up/Self Delivery*
CPFSA Information:			
1. Residential Diversion Rates:	*15%*	*3%*	*60%*
2. Residential Recyclables Tonnage:	*6,861*	*1,372*	*27,409*
3. Total Recyclables Tonnage:	*20,387*	*4,077*	*63,365*
4. Total Processing Cost:	*$1,036,064*	*$486,463*	*$6,695,946*
5. Residential Collection Cost:	*$1,939,630*	*$2,832,630*	*$3,754,090*
6. ICI Collection Cost:	*$1,093,240*	*$278,530*	*$2,641,230*
7. Total Revenue:	*$1,330,572*	*$266,104*	*$2,490,611*
8. Total Net System Cost:	*$2,738,362*	*$3,331,519*	*$8,282,774*
9. Total Net System Cost per Tonne: (of Recyclables)	*$134*	*$817*	*$131*
10. Total Net System Cost per Tonne of All Waste (excluding ICI collection costs):	*$16*	*$31*	*$57*
11. Processing Plant Capital Funding per Tonne of All Waste:	*$2*	*$1*	*$7*
Solid Waste Management Information:			
12. Total Net Recycling System Cost per Household (including capital funding and excluding ICI collection costs):	*$24*	*$51*	*$84*
13. Remaining Residential Solid Waste Collection Cost per Tonne:	*$49*	*$49*	*$0*
14. Residual Wastes Transportation Cost per Tonne:	*$0*	*$0*	*$3*
15. Landfill Disposal Cost per Tonne:	*$28*	*$30*	*$18*
16. Other Solid Waste Operations Costs per Household:	*$61*	*$63*	*$17*
17. Total Solid Waste Management System Cost per Household:	*$85*	*$114*	*$101*

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1. Refer to "Recycling Systems Cost Comparison Reference Guide" of Section 5.4 for explanation of all information elements and their source.

Table 5.33
Comparison of Annual Costs of Recycling System Options(1)

	CPFSA	SWM Region
Number/Name:		
Total Solid Waste (Tonnes):		
Residential Solid Waste (Tonnes):		
Total Households:		

Recycling Systems:	Full Service	Minimum Service	MaxRF Service
Residential:			
ICI:			
CPFSA Information:			
1. Residential Diversion Rates:			
2. Residential Recyclables Tonnage:			
3. Total Recyclables Tonnage:			
4. Total Processing Cost:			
5. Residential Collection Cost:			
6. ICI Collection Cost:			
7. Total Revenue:			
8. Total Net System Cost:			
9. Total Net System Cost per Tonne: (of Recyclables)			
10. Total Net System Cost per Tonne of All Waste (excluding ICI collection costs):			
11. Processing Plant Capital Funding per Tonne of All Waste:			
Solid Waste Management Information:			
12. Total Net Recycling System Cost per Household (including capital funding and excluding ICI collection costs):			
13. Remaining Residential Solid Waste Collection Cost per Tonne:			
14. Residual Wastes Transportation Cost per Tonne:			
15. Landfill Disposal Cost per Tonne:			
16. Other Solid Waste Operations Costs per Household:			
17. Total Solid Waste Management System Cost per Household:			

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1. Refer to "Recycling Systems Cost Comparison Reference Guide" of Section 5.4 for explanation of all information elements and their source.

Recycling Systems Cost Comparison Reference Guide

Table 5.33: Comparison of Annual Costs of Recycling System Options, begins with some general information regarding the names, the total and residential solid wastes tonnages generated, and the total households per CPFSA and per SWM Region. **Table** 5.32 indicates that the total solid waste tonnage information, as pertains to the CPFSA4 and Westmorland/Albert SWM Region, are 99,844, and 88,039 tonnes, respectively. The total SWM Region solid waste tonnages can be obtained from **Table** 2.1 by adding the residential and ICI tonnages, and the total CPFSA solid waste tonnages can be obtained from **Table** 5.1. Similarly, the residential solid waste tonnage and the total households per SWM Region can be obtained from Scenario 3 of **Table** 3.1, and the residential solid waste tonnage and total households per CPFSA from **Table** 5.1. Also included in the top portion of **Table** 5.33 are the choices of the recycling systems options. For the Westmorland/Albert SWM Region sample comparison the three Base Case systems are examined (ie. Full Service residential roadside collection and ICI pick-up; Minimum Service residential drop-off depots and ICI self-delivery; and MaxRF Service; residential roadside collection and ICI pick-up and self-delivery).

The next set of data (lines 1 to 11 in **Table** 5.33) is CPFSA Information.

1. Residential Diversion Rates: Diversion rates can be obtained from **Table** 5.10 for the Base Case residential recycling systems. As indicated in **Table** 5.32, the diversion rates of the Base Case recycling systems are 15% for Full Service Residential Roadside Collection, 3% for Minimum Service Residential Drop-off Depots, and 60% for MaxRF (Wet-Dry) Service Residential Roadside Collection. Diversion Rates for comparison of any recycling systems other than the Base Case systems may be obtained from **Tables** 5.19 to 5.28 or from the appropriate tables in the **Appendix C** Sensitivity Test tables.

2. Residential Recyclables Tonnage: Annual residential recyclables tonnages per CPFSA are provided for each of the Base Case recycling systems in **Table** 5.10. Other recycling system options residential recyclables tonnages per CPFSA are available in **Appendix C** Sensitivity Test tables.

3. Total Recyclables Tonnage: Annual total recyclables tonnages include both residential and ICI recyclable materials diverted from the total waste stream. **Table** 5.10 provides the total recyclables tonnages per CPFSA for each of the Base Case recycling systems. Other recycling system options total recyclables tonnages are available in the **Appendix** C Sensitivity Test tables.

4. Total Processing Cost: Total processing cost includes the annual amortized capital cost of the respective CPF and MaxRF processing plants plus their annual operations costs. Total processing costs per CPFSA of the three Base Case recycling systems are provided in **Table** 5.11. These processing costs include the processing of both residential and ICI recyclable materials. Other recycling system options processing cost can be obtained from the appropriate Sensitivity Test tables of **Appendix C**.

5. Residential Collection Costs: Annual residential collection costs per CPFSA of the three Base Case recycling systems are provided in **Table** 5.12. They include: Full Service Residential Roadside Collection, Minimum Service Residential Drop-off Depots, and MaxRF (Wet-Dry) Service Residential Roadside Collection. Residential collection costs include both the collection and delivery of recyclables to the CPF's and MaxRF's. It should be noted that the MaxRF recyclables collection costs include all residential waste delivered to the MaxRF plant for processing.

   The residential collection costs of other recycling system options can be obtained from **Tables** 5.19 to 5.27 or from the appropriate Sensitivity Test tables of **Appendix C**.

6. ICI Collection Cost: Annual ICI collection costs per CPFSA of the three Base Case recycling systems are also provided in **Table** 5.12. ICI collection systems include: Full Service ICI Pick-up, Minimum Service ICI Self-delivery and MaxRF ICI Pick-up and self-delivery. Note that the MaxRF ICI recyclables collection costs include all wastes delivered to the MaxRF plant for processing. The ICI collection costs of other recycling system options can be obtained from **Table** 5.30 or from the Sensitivity Test tables of **Appendix C**.

7. Total Revenue: The annual total revenues from the sale of recyclable materials per CPFSA are provided in **Table 5.13** for the three Base Case recycling systems. These total revenues per CPFSA include the sale of both residential and ICI processed recyclable materials. Annual total revenues received from other recycling system options are available by adding together the revenues from residential and ICI recyclable materials as provided in **Tables 5.30** and **5.31**, respectively. Annual total revenues from other recycling system options can also be obtained from the appropriate Sensitivity Test tables of **Appendix C**.

8. Total Net System Cost: Annual total net system costs of the recycling systems per CPFSA are the sum of the Processing Cost, Residential Collection Cost and ICI Collection Cost minus the Total Revenue provided in lines 4 through 7 above. The total net system costs per CPFSA for the Base Case recycling systems are provided in **Tables 5.14** to **5.18**. The total net system costs of other recycling system options are available from appropriate Sensitivity Test tables of **Appendix C**.

9. Total Net System Cost per Tonne (of Recyclables): the annual total net system costs per tonne of recyclables per CPFSA can be calculated by dividing the Total Net System Cost (ie. line 8 above) by the Total Recyclables Tonnage (ie. line 3 above). Total Net System cost per tonne of recyclables per CPFSA can also be obtained for the Base Case recyclable systems from **Tables 5.14** to **5.18**. The total net system options are available from the appropriate Sensitivity Test tables of **Appendix C**.

10. Total Net System per Tonne of All Waste (excluding ICI collection costs): The annual total net system costs per tonne of all waste excluding ICI collection costs per CPFSA are calculated by subtracting the ICI Collection Costs (ie. line 6 above) from the Total Net System Cost (ie. line 7 of above) and dividing the result by the Total Solid Waste (Tonnes) for the CPFSA (ie. 99,844 tonnes in **Table 5.32**) for each recycling system. The Total Net System Cost per Tonne of All Waste (excluding ICI collections costs) per CPFSA are also available from **Tables 5.14** to **5.18** for the Base Case recycling systems and from **Appendix C** Sensitivity Test tables for the other recycling system options.

11. Processing Plant Capital Funding per Tonne of All Waste: The processing plant capital funding can be calculated using information available in this study for each of the three recycling systems. To calculate the Provincial 50% capital funding grant on the CPF's or MaxRF plants take 50% of the Annual Capital provided in **Table** 5.11 for each recycling system and divide by the Total All Waste from **Table** 5.1.

The next set of data (lines 12 to 17 in **Table** 5.32) is Solid Waste Management Information. This information compiles the cost responsibilities of the SWM Regions. It is normally expected that ICI collection of recyclable materials will be retained as the responsibility of the private sector, as is presently the case with collection of their solid wastes. Therefore ICI collection costs have been excluded from the remainder of this recycling system comparative cost evaluation. The Solid Waste Management Information provides all of the necessary cost components to compare the three recycling systems on an equal basis.

12. Total Net Recycling System Cost per Household (including capital funding and excluding ICI collection costs): the annual total net recycling system cost per household includes the provincial capital funding of the processing plants and excludes the ICI collection costs. To calculate these per household net recycling system costs per CPFSA for each of the recycling systems first subtract the Processing Plant Capital Funding per Tonne of All Waste (line 11 of **Table** 5.33) from the Total Net System cost per Tonne of All Waste excluding ICI collection costs (line 10 of **Table** 5.33). Then the result is multiplied by the Total Solid Waste (Tonnes) of the CPFSA (from the top section of **Table** 5.33) and divide by the Total Households of the CPFSA (from the top section of **Table** 5.33).

    Using the Full Service recycling system of the Westmorland/Albert SWM Region example of **Table** 5.32, this calculation of the Total Net Recycling System Cost per Household would be: $16-$2 (line 11 for line 10) = $14/T.; then: ($14/T. x 99,844T/59,205 HH) = $24/Household (HH).

13. Remaining Residential Solid Waste Collection Cost per Tonne: The remaining residential solid waste (ie. garbage) collection cost per tonne for application to the Full and Minimum Service recycling systems must be obtained by the SWM Region from their background regional solid waste

alternatives studies, or otherwise. These figures are not available from this study, except in the example Westmorland/Albert Region case provided in **Table** 5.32 at $49 per tonne. The MaxRF Service will always have a zero cost, as all wastes are collected by the MaxRF roadside collection system; or in other words there are no remaining residential solid wastes to be collected.

14. Residual Waste Transportation Cost per Tonne: Residual wastes are a mixture of process residuals and other non-recyclable wastes, which accumulate at the CPF and MaxRF plants. They must be transported from the plants to the regional landfill disposal site for disposal. The CPF's generate an average of about 5% of residual wastes to be disposed, whereas the MaxRF's processing produces approximately 40% residential and 34% ICI residual waste for disposal.

    If the distance from CPF's or MaxRF's are provided by SWM Regions, residuals transportation cost estimates can be calculated using the following formulas:

    The first step is to calculate the residual waste tonnages per CPFSA (RWTC). The RWTC for Full and Minimum Service recycling systems are calculated by multiplying 0.05 times the Total Recyclables Tonnage (from line 3 above). The RWTC for MaxRF Service recycling system is calculated by subtracting the Total Recyclables Tonnage from the Total Solid Waste (Tonnes) for the CPFSA.

    The next step is to calculate the residual waste tonnage per SWM Region (RWTR). This is calculated for all recycling systems by multiplying the RWTC by Total Solid Waste (Tonnes) for the SWM Region (from the top section of **Table** 5.33) and dividing by the Total Solid Waste (Tonnes) for the CPFSA (from the top section of **Table** 5.33).

    The Residual Waste Transportation Cost per Tonne (RTC) are then calculated for each recycling system as follows:

    RTC = (($8 + ($0.11 x RDD)) x RWTR)/TSWR;

    where:

\$8 = the per tonne cost of residuals containment and handling;

(\$0.11 x RDD)= \$0.11 per tonne - kilometre of transporting residuals times the Round trip Distance to the Disposal site (as input by SWM Region);

RWTR = Residual Waste Tonnage of the SWM Region (as calculated above); and

TSWR = Total Solid Wastes (Tonnes) of the SWM Region (as given in the top section of **Table** 5.33).

a) Using the Westmorland/Albert case in **Table** 5.32 applied to the Full Service recycling system, and a zero distance assumed by the Westmorland/Albert Region (ie. the CPF's or MaxRF would be located at the regional landfill site), the formula equals:

RWTR = (0.05 x 6861) x (88,039/99,844) = 302
RTC = ((\$8 + (\$0.11 x 0)) x 302)/88,039 = \$0.03

As seen in **Table** 5.32 the Westmorland/Albert Residual Waste Transportation Costs per Tonne is given as \$0 (rounded off) for the Full Service recycling system.

b) For MaxRF Service recycling systems the residuals transportation costs per tonne (RTC) for the Westmorland/Albert Region case, where RDD=0,

RWTR = (99,844 - 63,365) x (88,039/99,844) = 32,166

RTC = ((\$8 + (\$0.11 x 0)) x 32,166)/88,039 = \$2.92

As seen in **Table** 3.32 the Westmorland/Albert Residual Waste Transportation Cost per Tonne is given as \$3 (rounded off) for the MaxRF service recycling system.

15. Landfill Disposal Cost per Tonne: The annual landfill disposal cost per tonne must also be obtained by the SWM Region from their background regional solid waste alternatives studies, or otherwise. It should be noted that the diversion of wastes from disposal may alter the per tonne solid waste disposal costs estimates based on the total waste disposal costs for the SWM Region. The Westmorland/Albert Region provided three different disposal costs per tonne for the three recycling systems, as indicated in **Table** 5.32. Note that the Landfill Disposal Cost per Tonne should include the Provincial 50% capital funding grant.

16. Other Solid Waste Operations Costs per Household: All of the other Solid Waste operations apart from the recycling systems include: the remaining residential solid waste (ie. garbage) collection; the transportation of residual wastes from the recycling processing plant to the landfill disposal site, and the landfill disposal operations. The other solid waste operations costs per household, as pertain to each of the recycling system options, are calculated by first adding the Remaining Residential Solid Waste Collection Cost per Tonne (line 13), the Residual Waste Transportation Cost per Tonne (line 14), and the Landfill Disposal Cost per Tonne (line 15). as available in **Table** 5.33. The results are then multiplied by the Residential Solid Waste (Tonnes) for the SWR Region (as available from the top section of **Table** 5.33) and divided by the Total Households for the SWM Region (also available from the top section of **Table** 5.33).

    Using the Full Service recycling system example from the Westmorland/Albert case in **Table** 5.32, the lines 13, 14 and 15 are added (ie. $49 + $0 + $28 = $77). Then the $77 is multiplied by 38,737 tonnes and divided by 48,580 households to get $61 per household. This converts the three other solid waste operations costs per tonne to costs per household.

17. Total Solid Waste Management System Cost per Household: To calculate the annual total solid waste management system cost per household for each recycling system simply add the Total Net Recycling System Cost per Household (of line 12) to the Other Solid Waste Operations Costs per household (of line 16). This provides the "bottom line" sum of all of the solid waste management system cost components associated with each recycling system on a per household basis. Fair comparisons can, therefore,

be made among the three recycling system approaches - Full Service, Minimum Service or MaxRF Service, using these costs.

Table 5.32 presents the bottom line comparison of the Westmorland/Albert SWM Region Total Solid Waste Management System Cost per Household associated with the three Base Case recycling systems at $85 per household for Full Service, $114 per household for Minimum Service, and $101 per household for MaxRF Service. For an indication of the relative effectiveness of the three recycling systems, refer also to the Residential Diversion Rates provided in line 1 of the table.

6.0 FEASIBILITY OF A CENTRAL MARKETING AGENCY FOR RECYCLABLES

6.0 FEASIBILITY OF A CENTRAL MARKETING AGENCY FOR RECYCLABLES

6.1 Evaluation of Central Marketing Structures

The concept of a single agency holding sole responsibility for the marketing of all material produced by the five CPFSA's has been reviewed by the Study Team. In studying the strengths and weaknesses of the idea it became very clear that an organization charged with the marketing responsibility must have as its objective the optimization of revenues with the goal of reducing the costs of recycling for the ratepayers of each region. Consequently the marketing authority should ideally be an agent of the solid waste management regions and report to them through their CPFSA.

Before arriving at this conclusion other management structures for such an agency were investigated. Included in the review were provision of common marketing by: a provincial government department or agency, a crown corporation, tendering to brokers, a private corporation, and one of the regional commissions. **Table 6.1** below summarizes the results of the inquiry. Each of the organizational structures was evaluated in terms of its ability to respond to specific required capabilities and, where relevant, to the three levels of production.

The installation of a marketing group into an existing government department or agency was found to be inefficient and capable of responding only to demands of the Minimum Service (residential depots and ICI Self-delivery) recycling system. It was viewed as able to respond to needs for programs to increase public awareness and participation and to undertake advertising and promotional activities. But it was not seen as being able to monitor or control the quality of the recycled products, to maintain high customer relationships or to enter into cost share agreements since any revenues received would be applied to general revenues.

The establishment of a crown corporation to respond to the specific requirements of a central marketing agency would at first appearance appear to be the answer. However, with no outside control over staffing or office expense it would not be directed to achieve the objective established for the organization.

Tendering to a broker, while perhaps obtaining the best price for the least administration cost, responds to few of the other responsibilities for the agency.

TABLE 6.1

MARKETING AGENCY STRUCTURE & CAPABILITY EVALUATION MATRIX

Capability	Case	Department or Agency	Crown Corporation	Tender to Broker	Private Corporation	Regional Commission	Authority Responsible to Commissions
Establish and secure markets for all materials	Mini	x	x			x	
	Full		x	x	x	x	x
	Max RF		x	x	x		x
Capture volume price benefits	Mini	x	x			x	
	Full		x	x	x	x	x
	Max RF		x	x	x		x
Coordinate use of jointly owned equipment	Mini	x	x			x	x
	Full		x			x	x
	Max RF		x				x
Coordination of production and Dispatching	Mini	x	x			x	x
	Full		x		x		x
	Max RF		x		x		x
Promotion/publicity	all	x	x				x
Customer relationships	all		x	x	x		x
Quality control	all		x		x		x
Establish cost-share	all		x		x	x	x
Maintain accountability	all						x
Ensure highest returns to individual commissions	Mini					x	
	Full			x			x
	Max RF			x			x

There may however be some merit in combining, within other structures, the tendering of specific lower volume recycled products from the Full Service residential roadside collection and ICI pick-up or MaxRF Service (residential MaxRF roadside collection and ICI MaxRF pick-up and self-delivery) recycling systems.

The awarding of responsibility for the marketing of all recycled products to a private corporation would only be feasible for the large scale recycling systems (Full Service and MaxRF Service), where there would be sufficient revenues to allow the venture to take a percentage of the total sales. A private venture while providing most of the required capabilities, certainly could not be expected to provide the promotion and publicity needed to expand the individual CPFSA's.

The acceptance by one regional commission or by management of a CPFSA to assume marketing responsibilities at the provincial level is, in our opinion, not feasible. Even at the Minimum Service level conflicts are bound to occur between the regional and provincial demands of time and effort, and when that happens the more immediate local demands will take precedence.

The final option reviewed was the establishment of an organization or authority which would be responsible to the solid waste management regions or individuals representing each of the CPFSA's. Such an organizational structure would not only be self supporting, it would, under the eyes of the CPFSA's, necessarily be lean and efficiently staffed to maintain overhead at minimum levels. The authority would most effectively handle the larger volumes generated by the Full Service and MaxRF Service recycling systems. The Minimum Service recycling system is not estimated to provide sufficient sales to support both the marketing agency and the CPFSA's. In addition to responding to the consolidated marketing efforts, the agency would also be the most effective tool to undertake/coordinate public awareness and promotional programs.

6.2 Volume Marketing

Volume marketing of products recovered from residential and industrial waste was found to provide several benefits. For some products, such as plastics and aluminum cans, the recycler may institute a two price system. At one level, for suppliers or brokers who can guarantee specific sized loads on a pre-arranged schedule, the purchaser will pay at say $100.00 per tonne, for all other deliveries he may pay only $40.00 per tonne or less depending on the size of the load.

For other products a purchaser may sign a fixed price agreement for an annual requirement to be delivered on a defined schedule. While the price may not be above the norm, it is constant for the period of the contract, thereby avoiding sales on the spot market where prices maybe highly variable. The added advantages of a term contract is that it enables the marketing agency to divert their sales efforts to obtaining better markets for the remaining products and for budgeting purposes.

One distinct way of obtaining higher prices is by combining high volumes with quality controlled to the specifications of the buyer. For instance, clean corrugated cardboard, baled and free of glue and tape brings the producer as much as three times the return that regular post-consumer boxes provide.

A review of quotes received from purchasers revealed that for larger volumes there is potentially up to 17 percent increase in prices offered. For the purposes of this portion of the study a 15 percent price increase for volume sales was considered as reasonable.

6.3 Marketing Agency Organization

As noted above, the volumes of recycled materials produced by the Minimum Service recycling systems are insufficient to permit a marketing agency to increase financial returns to the CPFSA's and at the same time generate enough funds to cover its own expenses. Therefore the Study Team recommends that a central marketing agency be established only if Full Service or MaxRF Service recycling systems are implemented. In this section the economies of each CPFSA performing their own marketing versus a central agency performing all marketing activities for each of the five CPFSA's are compared for the two Full Service and MaxRF Service recycling system scenarios.

6.3.1 Full Service Recycling Scenario

For the Full Service Recycling System Scenario approximately 95 thousand tonnes of recycled products will be produced by the five CPFSA's. There is a considerable range in the volume produced by the individual facilities - from 9,600 tonnes to more than 28,000 tonnes, but in all cases the majority of the recycled materials are newspapers, cardboard and other paper products (87% to 91%). Consequently, even for the CPFSA with the lowest level of recycled product they will be shipping an average of five or more tractor trailer loads of newspaper, cardboard and other paper (30 tonnes per load) every week of the year. For the CPFSA with the greatest production they will be shipping an average of sixteen loads per week.

In either the Full Service or MaxRF Service recycling scenarios the sales and transportation arrangements (dispatching) will require, at each of the CPFSA's the involvement of a minimum of one individual, on a year round basis. Salaries will vary with level of responsibility but should average around $39,000 per year (1991 dollars) plus 25 percent to cover employer paid benefits. A summary of staff requirements for the five CPFSA's is provided in **Table 6.2**. Office space and equipment amortization will add approximately $3,000 per year and office and travel expenses another $6000 per year on average a outlay per CPFSA of $51,500.

The costs of increasing and maintaining public awareness and participation will also be borne by the individual CPFSA. For the Full Service recycling scenario it has been assumed that the general manager of the CPFSA will award contracts to agencies to design and carry out the required promotion within a predefined budget. For the purposes of the study the individual promotional budgets of each of the five CPFSA's were estimated to average $50,000 per year.

The establishment of a centralized marketing organization will require for the Full Service recycling scenario a dedicated staff capable of marketing and organizing the transportation of an average of more than sixty, 30 tonne loads of recycled waste products each week of the year. This will cover eleven or more recyclable products, of which newspaper, cardboard and other paper will constitute almost 90 percent of the total.

The staff required to operate the centralized marketing agency for the Full Service recycling scenario is expected to total four. They would have the following responsibilities:

TABLE 6.2

STAFF REQUIREMENTS AND COSTS OF INDIVIDUAL CPFSA'S MARKETING

Position	Responsibilities	No.	Average Wage	Total Wage & Benefits
Manager	Sales and dispatching	2	$39,000	$97,500
Manager	Sales (>20 loads/week)	3	$39,000	$146,250
Ass't Manager	Dispatching	3	$32,000	$120,000
Ass't Manager	Public Awareness & Promotion	5	$30,000	$187,500
			TOTAL	$551,250

Manager - would be responsible for all sales, general management of the organization, reporting to the board of directors (CPFSA representatives), annual budget preparation and negotiation of cost share agreements, establishment of product standards following negotiations with buyers and board of directors, and quality assurance verification;

Dispatcher - under direction of the manager would be responsible for negotiation of contracts for pick-up and delivery of the processed recyclable material; and would assist the manger with quality assurance inspection and verification;

Clerk-Secretary - would be responsible to maintain up-to-date records of production by the individual CPFSA's, preparing all invoices and payment cheques on a bi-weekly basis, recording all minutes of the board meetings and providing secretarial services to the Manager and the Dispatcher, as well as to such other staff as may be required for public awareness and promotion; and

Promotions Supervisor- will be responsible for increasing and maintaining public awareness and participation under a common program for all five CPFSA's.

It would be expected that all staff would start at the low end of their salary ranges which have been estimated as follows:

Manager - $49,000-54,000;
Dispatcher - $34,000-39,000;
Clerk Secretary - $24,000-29,000; and
Promotions Supervisor - $34,000-39,000

Employee benefits paid by the employer have been estimated at 25 percent of annual wages. A summary of staff requirements and costs of a central marketing agency is provided in Table 6.3.

TABLE 6.3

STAFF REQUIREMENTS AND COSTS OF CENTRAL MARKETING

Position	Responsibilities	No.	Average Wage	Total Wage & Benefits
General Manager	Sales and Management	1	$54,000	$67,500
Clerk Secretary	Records and Invoices	1	$29,000	$36,250
Ass't Manager	Transportation & Sales	1	$39,000	$48,750
Ass't Dispatcher	Transportation	1	$30,000	$37,500
Quality Supervisor	Quality Standards & Inspection	1	$34,000	$42,500
Advertising Manager	Public Awareness & Promotion	1	$39,000	$48,750
Receptionist/Steno.	Reports, etc.	1	$19,000	$23,750
			TOTAL	**$305,000**

Office space, estimated at 1500 square feet, will include a boardroom and space for those identified above. At an annual rate of $20.00 per square foot plus taxes the yearly rental is estimated at $34,500. Office hardware, software and furniture has been estimated on the basis of an average annual cost of $10,000. Annual operation expenses for light telephone, facsimile, and supplies have been estimated at $6000, travel expenses at $18,000 per year based on one out of province every two months and 6 out of town/in province trips per month. Promotional material was estimated at $150,000 per year.

A comparison between the costs and revenues arising from the individual CPFSA's providing their own sales, dispatching and promotion and those produced by a central agency are provided in **Table 6.4** for the Full Service recycling system scenario.

6.3.2 MaxRF Service Recycling Scenario

The MaxRF Service recycling scenario is based on the recovery of seventeen products from the CPFSA MaxRF plants. The major product recovered is compost material which was estimated to have a value of up to $9.00 per tonne. For the purpose of this comparison the compost material will be ignored since it will have to be sold in bulk at the local level.

In this scenario the deliveries from the individual CPFSA MaxRF plants would range from an average of 11.8 tractor-trailer loads per week from the Madawaska, Victoria, Carleton CPFSA1 plant to a high of 35.0 loads per week from the Saint John, Kings and Charlotte CPFSA3 facility. The average total delivery of material from the five CPFSA's is estimated to be over 116 trailer loads per week, based on 20 tonne loads of plastics and 30 tonne loads for all other material.

The Study Team has reviewed the work load requirements and is of the opinion that when more than 20 trailer loads are, on an average, shipped from a processing plant that there will have to be a dispatcher as well as an individual responsible for the selling of the material. In addition to the sales and dispatching employees, a public awareness/promotion position will also have to be filled at each CPF.

TABLE 6.4

COST COMPARISON OF INDIVIDUAL CPFSA VERSUS CENTRAL MARKETING - FULL SERVICE RECYCLING SCENARIO

	Total for 5 CPFSA's	Total for Central Agency
Wages and Benefits	5 sales/dispatchers $212,500	Manager, Dispatcher, Clerk/Secretary & Promotions Supervisor $176,250
Office Space	No cost included	Estimated at $20.00 per square foot for 1,500 sq ft plus taxes $34,500
Office Furniture and Equipment	For five professionals $15,000 amortized at 20% $3,000	For three professionals and one support staff $50,000 amortized at 20% $10,000
Office Expense and Supplies	At $200 per year per CPF $1,000	For electricity, telephone, fax and supplies $6,000
Travel Expenses	At $1,000 per year per CPF $5,000	To cover visits to CPFs and out-of provincial $18,000
Promotional Material	At $50,000 per year per CPF $250,000	Cost savings through larger runs $150,000
Estimated Total Cost	$471,500	$394,750
Estimated Revenue	$6,133,704	$6,133,704
Increased Revenue from Volume Marketing		$920,056
Cost as percent of gross revenue	7.7%	5.6%

The pay scale estimates for these positions have been provided in **Table 6.2**. For a central sales and promotion agency the staff requirements and cost estimates have been given in **Table 6.3**. Other costs to be included in the comparison are office rental, furniture and equipment, office materials and expenses, promotion and travel expenses. They have been estimated and are provided in **Table 6.5** for the MaxRF Service recycling system scenario.

6.4 Summary of Central Marketing Agency

The introduction of a single agency to sell the recycled waste and promote recycling at the provincial level is valid from the objective of optimizing net revenues and for the goal of reducing net costs of recycling to rate payers.

The agency should be an authority with a representative board of directors, one appointed by each CPFSA and/or SWM Region, and possibly one appointed by the Province.

The centralized agency showed a measurable benefit over the decentralized sales and promotion by the individual CPFSA's for the Full Service and MaxRF Service recycling system scenarios. The Minimum Service recycling scenario had insufficient recovery rates to support a central agency. **Table 6.6** identifies the estimated sales and promotional costs as a percent of estimated revenues for the two Full and MaxRF Service recycling scenarios.

TABLE 6.5

COST COMPARISON OF INDIVIDUAL CPFSA VERSUS CENTRAL MARKETING - MAXRF SERVICE RECYCLING SCENARIO

	Total for 5 CPF's	Total for Central Agency
Office Space	Estimated as no-cost since it would be co-located with individual CPFs.	Estimated at $20 per sq ft per year for 2,500 sq ft plus taxes $57,500
Office furniture and equipment	For 13 professionals - photocopiers, printers, tax and telephone provided by CPFs. Average cost of $6,000 per person $78,000 amortized at 20% $15,600	For 5 professionals & 2 support staff Includes boardroom and reception area, photocopier, printer, fax, telephones, etc. Total cost of $86,000 amortized at 20% $17,200
Office material and Supplies	Estimate at $50 per month per person $7,800	Estimated at $75 per month per person $6,300
Promotional material	Estimated at $50,000 per CPF $250,000	Estimated to provide a savings of 40% $150,000
Travel Expenses inspection,	Travel outside of region estimated at 6 times per year at $400 per trip for a total of $12,000	Travel to each region for promotion and by regional board members to Agency. 300 trips at $150/trip. Out of province trips 6 @ $1,200 for total of $52,200
Estimated Total Costs	$836,650	$588,200
Estimated Revenue	$11,630,635	$11,630,635
Increased Revenue from Volume Marketing - 15%		$1,744,595
Cost as percent of gross revenue	7.2%	4.4%

TABLE 6.6

SUMMARY COMPARISON OF INDIVIDUAL CPFSA VERSUS CENTRALIZED MARKETING

	Total for 5 CPFSA's Recycling Scenario		Total for Central Agency Recycling Scenario	
	Full Service	**Max RF Service**	**Full Service**	**Max RF Service**
Estimated Cost	$471,500	$836,650	$394,750	$588,200
Estimated Revenue	$6,133,704	$11,630,635	$7,053,760	$13,375,230
Cost as % of Revenue	7.7%	7.2%	5.6%	4.4%

APPENDIX A

LIST OF REFERENCES

LIST OF REFERENCES

- Westmorland/Albert Region Waste Audit, Westmorland/Albert Solid Waste Management Committee, 1989.
- Audit/Acadian Peninsula, Comité de Gestion de Déchets Solides de la Péninsule Acadienne, 1989.
- Waste Audit Report, Kings County Region Solid Waste Management Provisional Committee, 1989.
- Waste Audit Report, Committees for Solid Waste Management - Kent, 1989.
- Waste Audit, Restigouche Region Solid Waste Provisional Committee, 1989.
- Phase I Waste Audit, Northumberland Region Solid Waste Provisional Committee, 1990.
- Phase I - Waste Audit, Fundy Solid Waste Action Team, 1990.
- Solid Waste Management Alternatives for Saint John and Kings County, N.B. Municipal Affairs and Environment, 1988.
- Census Division and Subdivisions - 1986, Statistics Canada.
- Transfer Station Manual, Alberta Environment, 1982.
- Solid Wastes: Engineering Principles and Management Issues, G. Tchobanoglous, 1977.
- The Fredericton Recycling Experience, N.B. Department of the Environment, 1990.
- Municipal Refuse Statistics for Canadian Communities Over 100,000, Bird & Hale Ltd., 1979.
- Characterization of Municipal Solid Waste in the United States, 1960 to 2000, Franklin Associates Ltd., 1988.
- Municipality of Toronto - Recycled Materials Processing Facilities Study, R. Cave and Associates Ltd., 1988.
- Solid Waste Management in New Brunswick, N.B. Department of Municipal Affairs and Environment, 1987.
- Municipality of Durham Full Scale Pilot Central Composting Facility Preliminary Engineering Report, R. Cave and Associates Ltd., 1990.
- Recycling Technology Manual, Resource Integration Systems, 1987.
- Characterization of Municipal Solid Waste in the United States - 1960 to 2000 (update 1988), Franklin Associates Ltd. 1988.
- A Guide to Recycling in Maine, Maine Department of Environmental Protection, 1989.
- Reduction by Recycling, COGEDES - Comité de Gestion des Déchets Solides de la Péninsule Acadienne, 1990.

- Assessment of Solid Waste Alternatives, Northumberland Region Solid Waste Provisional Committee.
- Recycling, Restigouche Solid Waste Committee, 1990.
- Nova Scotia Environmental Assessment Act, N.S. Minister of Environment, 1988.
- Environmental Review Process for Highway Projects in Nova Scotia, N.S. Department of the Environment, 1990.
- Planning and Implementation of Recycling for Solid Waste Committees and Commissions, N.B. Dept. of Municipal Affairs and Environment, 1988.
- Guide to Residential Source Separation, Ontario Ministry of the Environment, 1988.
- City of Chatham Recycling Feasibility Study, Gore & Storrie Ltd. in Association with R. Cave & Associates Ltd, 1990.
- Kings County Blue Box Recycling Project - Interim Report, N.S. Dept. of the Environment et. al., 1990.
- Ontario Waste Composition Study Volume I - Residential Waste, Ontario Ministry of the Environment, 1991.
- Recycling Today - Equipment and Services Directory, GIE Inc. Publishers, Aug. 1990.
- Biocycle - Journal of Waste Recycling - Vol. 31, No. 10, JG Press, Inc., October, 1990.
- Biocycle - Journal of Waste Recycling - Vol. 30, No. 6, JG Press Inc., June 1989.
- Review of Alternatives, Kings County Region Solid Waste Management Provisional Committee, 1989.
- City of Guelph - Full Scale 'Wet/Dry' Processing Facilities - Preliminary Engineering, R. Cave and Associates Ltd., 1990.
- Rural Garbage Collection in New Brunswick, N.B. Dept. of Municipal Affairs and Environment, 1987.
- Westmorland/Albert Region Waste Management Alternatives, Westmorland/Albert Solid Waste Provisional Committee, 1989.
- Composting: It's Role in Municipal Solid Waste Management, Environmental Sciences Research Centre, 1990.
- Review of Alternatives, Committee for Waste Management - Kent County, 1989.
- Designing and Implementing a Recycling Program, various, 1990.
- Recycling Container Choices, Elaine Schmerling, March, 1990.
- Recycling Participation Assessment, Sherrie Gruder Adams, September, 1990.
- "Recyclers Find Alternate Methods for Curbside Success", Recycling Today, Susan Gibson, July 1990.

- New Approach to Collecting Recyclables, Jim Glenn, November, 1989.
- Strategic Shift to Source Reduction, Pete Grogan and Brad Schwartz, January, 1991.
- Curbside Recycling Reaches 40 Million, Jim Glenn, July 1990.
- "Large Cities Try to Cut Collection Costs with Blue Bag Systems", Recycling Times, Jamie Hill, January 15, 1991.

APPENDIX B

RECYCLING STUDY CONTACT LIST

RECYCLING STUDY CONTACT LIST

NAME	ORGANIZATION
Arsenault, Bob	Maritime Soil Limited
Bagley, Richard	City of Fredericton, NB
Bagnell, James	Inland Oil Limited, Halifax, NS
Baird, David	Fundy SWAT
Bald, Jim	City of Halifax, NS
Bourgeois, Robert	Kent County Solid Waste Committee
Brun, Donald	Shediac Pallet, Shediac, NB
Bullough, Vaughn	Consumers Glass Ltd., Moncton, NB
Claus, Joanne	Irving Ltd.
Comeau, Ian	Restigouche Solid Waste Committee
Cook, Catherine	Metropolitan Works Department
Coombs, Karen	Charlotte County Recyclers
Cormier, Charlie	Cormier Recycler, Memramcook, NB
Cruichshank, Murray	Ryan Investments
Demarer, Jean-Claude	Papier Cascade Inc., Kingsley Falls, ON
Demers, Marcel	Peloquin Recyclage, Montreal, PQ
Dicinzo, Mike	Achievor Tire Inc., Mississauga, ON
Farrell, Jean	Minas Basin Pulp and Paper Company Limited
Gallant, Michael	Gallants Recycling
Gray, Parker	DOE
Grondin, Jean	Eastman Kodak, Montreal, PQ
Gruder Adams, Sherrie	City of Fitchburg, WN
Hamp, Bob	Environmental Plastic Industry Canada
Hann, Kelly	Twinpack, Inc., ON
Hantho, Carl	Dupont Inc., Montreal, PQ
Harris, Norma	Crosswinds Recycling, Sussex, NB
Hoffman, Ray	City of Seattle, WA

NAME	ORGANIZATION
Inenberg, Carol	Regional Waste Systems, Portland, ME
Johnson, Colin	Quebec and Ontario Paper Company Inc.
King, Stephen	Engineering and Works Department
Kuluk, Tony	City of Winnipeg, MN
Landry, Pierre	Westmorland/Albert Solid Waste Management Committee
LeBlanc, Gary	Acadian Peninsula Solid Waste Committee
Lomax, Caroline	Canadian Polystyrene Recycling, Mssissauga, ON
Lutes, Robert	DOE
Mackie, Bob	Twinpack Inc., Moncton, NB
MacMillan, Burns	Fundy SWAT
Martin, Helene	Commission d'Urbanisme du Madawaska/DOE
McGaughey, Harold	CR Inc., ME
McHugh, Sean	City of Pittsburg, PA
Michaud, Roger	Fraser Inc., Edmundston, NB
Miller, Craig	Amoco Foam Products Company
Montcalm, Greg	Ontario Ministry of the Environment
Parkhill, Janet	NB Department of Environment
Paulawich, John	Dofasco Inc.
Peabody, George	Carleton County Recyclers
Pert, Reid	Fredericton Solid Waste Commission
Primeau, Michel	Alcan Recycling Canada, Montreal, PQ
Ramarez, George	Domtar Packaging
Reynolds, Eleanor	Supewood Ontario Ltd., Mississauga, ON
Robichaud, Jean-Guy	Nepisiguit-Chaleur Solid Waste Commission
Sawyer, John	Thermocell Insulation Ltd.
Sparks, Ed	Abitibi-Price Inc., Chandler, PQ

NAME	ORGANIZATION
Steeves, Pat	Juniper Recycling, Moncton, NB
Synder, Mike	City of Chicago, IL
Theriault, Pierre	Fredericton Solid Waste Commission
Toner, Pat	DOE
Tremblay, Christine	L'Association canadienne des producteurs de pates et papiers
Urquhart, Dave	City of Fredericton
Van Rooyen, Brian	Municipality of Kings County, NS
Wattleling, Mr.	Stone-Consolidated Inc., Newcastle, NB
Waugh, Joe	Kings Regional Solid Waste Committee
Went, Fred	Metropolitan Authority, Halifax, NS
Wipple, John	Saint John Recycling
Wood, Don	DOE
Wort, Andrew	Northumberland Solid Waste Committee
	Canbrands International Ltd.
	Clyclomet
	Comtar Inc., ON
	Laidlaw Environmental Services Ltd.
	Moncton Recycling, Moncton, NB
	National Association for Plastic Container Recovery
	Plastic Again, Leominister, MA
	Resource Recovery, Orangeville, ON
	Sussex Manufacturing, Moncton, NB
	Uthane Research Limited Unionville, ON

APPENDIX C

DETAILED BASE CASE AND SENSITIVITY TEST ANALYSES OF RECYCLING SYSTEM OPTIONS

Table C1
Recycling System Options - Costs

Option: **BASE CASE #1**

Residential System: **Roadside Collection - Blue Box**
Vehicles: **SDRV (PL)**
Diversion: **15%**

ICI System: **Pick-Up Service**
Vehicles: **Roll-off Truck, Cube Van**
Diversion: **25%**

	CPFSA1	*CPFSA2*	*CPFSA3*	*CPFSA4*	*CPFSA5*
Households:	31,462	34,900	62,291	59,205	55,656
Residential Waste Tonnage:	28,925	41,374	71,826	45,743	51,817
ICI Waste Tonnage:	21,042	34,112	71,165	54,101	56,484
Total Waste Tonnage:	49,967	75,486	142,991	99,844	108,301
Residential Recyclables Tonnage:	4,339	6,206	10,774	6,861	7,773
ICI Recyclables Tonnage:	5,261	8,528	17,791	13,525	14,121
Total Recyclables Tonnage:	9,599	14,734	28,565	20,386	21,893
Plant Capital Costs:	$397,620	$397,620	$397,620	$397,620	$397,620
Plant Operations Costs:	$518,620	$567,550	$855,347	$638,444	$655,409
Total Plant Costs:	$916,240	$965,170	$1,252,967	$1,036,064	$1,053,029
Residential Collection Costs:	$1,510,590	$1,256,730	$2,231,210	$1,939,630	$2,493,580
ICI Collection Costs:	$786,510	$790,870	$1,388,640	$1,093,240	$1,486,980
Total Collection Costs:	$2,297,100	$2,047,600	$3,619,850	$3,032,870	$3,980,560

Note: All costs and tonnages are annual estimates based on Year 1991.

Table C1 (cont'd)
Recycling System Options - Costs

Option: **BASE CASE #1**

Residential System: **Roadside Collection - Blue Box**
Vehicles: **SDRV (PL)**
Diversion: **15%**

ICI System: **Pick-Up Service**
Vehicles: **Roll-off Truck, Cube Van**
Diversion: **25%**

	CPFSA1	*CPFSA2*	*CPFSA3*	*CPFSA4*	*CPFSA5*
Total System Costs:	$3,213,340	$3,012,770	$4,872,817	$4,068,934	$5,033,589
Total System Costs: (excluding ICI collection)	$2,426,830	$2,221,900	$3,484,177	$2,975,694	$3,546,609
Total Recyclables Revenue:	$604,348	$936,728	$1,841,200	$1,330,572	$1,420,856
Total Net System Costs:	$2,608,992	$2,076,042	$3,031,617	$2,738,362	$3,612,733
Total Net System Costs: (Excluding ICI Collection Costs)	$1,822,482	$1,285,172	$1,642,977	$1,645,122	$2,125,753
Plant Costs per Tonne: (of Total Recyclables)	$95	$66	$44	$51	$48
Net Plant Costs per Tonne: (of Total Recyclables)	$32	$2	($21)	($14)	($17)
Collection Costs per Tonne: (of Total Recyclables)	$239	$139	$127	$149	$182
Residential Collection Costs per Tonne: (of Residential Recyclables)	$348	$202	$207	$283	$321
Total Net System Cost per Tonne: (of Total Recyclables)	$272	$141	$106	$134	$165
Total Net System Cost per Tonne - All Wastes (Excluding ICI Collection Costs)	$36	$17	$11	$16	$20
Total Net System Cost per Household - All Wastes (Excluding ICI Collection Costs)	$58	$37	$26	$28	$38

Note: All costs and tonnages are annual estimates based on Year 1991.

Table C2
Recycling System Options - Costs

Option: **BASE CASE #2**

Residential System: **Roadside Collection - Stackable Bins**
Vehicles: **SDRV (PL)**
Diversion: **15%**

ICI System: **Pick-Up Service**
Vehicles: **Roll-off Truck, Cube Van**
Diversion: **25%**

	CPFSA1	*CPFSA2*	*CPFSA3*	*CPFSA4*	*CPFSA5*
Households:	31,462	34,900	62,291	59,205	55,656
Residential Waste Tonnage:	28,925	41,374	71,826	45,743	51,817
ICI Waste Tonnage:	21,042	34,112	71,165	54,101	56,484
Total Waste Tonnage:	49,967	75,486	142,991	99,844	108,301
Residential Recyclables Tonnage:	4,339	6,206	10,774	6,861	7,773
ICI Recyclables Tonnage:	5,261	8,528	17,791	13,525	14,121
Total Recyclables Tonnage:	9,599	14,734	28,565	20,386	21,893
Plant Capital Costs:	$397,620	$397,620	$397,620	$397,620	$397,620
Plant Operations Costs:	$518,620	$567,550	$855,347	$638,444	$655,409
Total Plant Costs:	$916,240	$965,170	$1,252,967	$1,036,064	$1,053,029
Residential Collection Costs:	$1,607,810	$1,256,730	$2,423,690	$2,122,570	$2,665,560
ICI Collection Costs:	$786,510	$790,870	$1,388,640	$1,093,240	$1,486,980
Total Collection Costs:	$2,394,320	$2,047,600	$3,812,330	$3,215,810	$4,152,540

Note: All costs and tonnages are annual estimates based on Year 1991.

Table C2 (cont'd)
Recycling System Options - Costs

Option: **BASE CASE #2**

Residential System: **Roadside Collection - Stackable Bins**
Vehicles: **SDRV (PL)**
Diversion: **15%**

ICI System: **Pick-Up Service**
Vehicles: **Roll-off Truck, Cube Van**
Diversion: **25%**

	CPFSA1	*CPFSA2*	*CPFSA3*	*CPFSA4*	*CPFSA5*
Total System Costs:	$3,310,560	$3,012,770	$5,065,297	$4,251,874	$5,205,569
Total System Costs: (excluding ICI collection)	$2,524,050	$2,221,900	$3,676,657	$3,158,634	$3,718,589
Total Recyclables Revenue:	$604,348	$936,728	$1,841,200	$1,330,572	$1,420,856
Total Net System Costs:	$2,706,212	$2,076,042	$3,224,097	$2,921,302	$3,784,713
Total Net System Costs: (Excluding ICI Collection Costs)	$1,919,702	$1,285,172	$1,835,457	$1,828,062	$2,297,733
Plant Costs per Tonne: (of Total Recyclables)	$95	$66	$44	$51	$48
Net Plant Costs per Tonne: (of Total Recyclables)	$32	$2	($21)	($14)	($17)
Collection Costs per Tonne: (of Total Recyclables)	$249	$139	$133	$158	$190
Residential Collection Costs per Tonne: (of Residential Recyclables)	$371	$202	$225	$309	$343
Total Net System Cost per Tonne: (of Total Recyclables)	$282	$141	$113	$143	$173
Total Net System Cost per Tonne - All Wastes (Excluding ICI Collection Costs)	$38	$17	$13	$18	$21
Total Net System Cost per Household - All Wastes (Excluding ICI Collection Costs)	$61	$37	$29	$31	$41

Note: All costs and tonnages are annual estimates based on Year 1991.

Table C3
Recycling System Options - Costs

Option: **BASE CASE #3**

Residential System: **Roadside Collection - Blue Bag**
Vehicles: **Packer (SL)**
Diversion: **15%**

ICI System: **Pick-Up Service**
Vehicles: **Roll-off Truck, Cube Van**
Diversion: **25%**

	CPFSA1	*CPFSA2*	*CPFSA3*	*CPFSA4*	*CPFSA5*
Households:	31,462	34,900	62,291	59,205	55,656
Residential Waste Tonnage:	28,925	41,374	71,826	45,743	51,817
ICI Waste Tonnage:	21,042	34,112	71,165	54,101	56,484
Total Waste Tonnage:	49,967	75,486	142,991	99,844	108,301
Residential Recyclables Tonnage:	4,339	6,206	10,774	6,861	7,773
ICI Recyclables Tonnage:	5,261	8,528	17,791	13,525	14,121
Total Recyclables Tonnage:	9,599	14,734	28,565	20,386	21,893
Plant Capital Costs:	$397,620	$397,620	$397,620	$397,620	$397,620
Plant Operations Costs:	$518,620	$567,550	$855,347	$638,444	$655,409
Total Plant Costs:	$916,240	$965,170	$1,252,967	$1,036,064	$1,053,029
Residential Collection Costs:	$1,449,900	$1,179,690	$2,108,730	$1,804,660	$2,382,483
ICI Collection Costs:	$786,510	$790,870	$1,388,640	$1,093,240	$1,486,980
Total Collection Costs:	$2,236,410	$1,970,560	$3,497,370	$2,897,900	$3,869,463

Note: All costs and tonnages are annual estimates based on Year 1991.

Table C3 (cont'd)
Recycling System Options - Costs

Option: **BASE CASE #3**

Residential System: **Roadside Collection - Blue Bag**
Vehicles: **Packer (SL)**
Diversion: **15%**

ICI System: **Pick-Up Service**
Vehicles: **Roll-off Truck, Cube Van**
Diversion: **25%**

	CPFSA1	*CPFSA2*	*CPFSA3*	*CPFSA4*	*CPFSA5*
Total System Costs:	$3,152,650	$2,935,730	$4,750,337	$3,933,964	$4,922,492
Total System Costs: (excluding ICI collection)	$2,366,140	$2,144,860	$3,361,697	$2,840,724	$3,435,512
Total Recyclables Revenue:	$604,348	$936,728	$1,841,200	$1,330,572	$1,420,856
Total Net System Costs:	$2,548,302	$1,999,002	$2,909,137	$2,603,392	$3,501,636
Total Net System Costs: (Excluding ICI Collection Costs)	$1,761,792	$1,208,132	$1,520,497	$1,510,152	$2,014,656
Plant Costs per Tonne: (of Total Recyclables)	$95	$66	$44	$51	$48
Net Plant Costs per Tonne: (of Total Recyclables)	$32	$2	($21)	($14)	($17
Collection Costs per Tonne: (of Total Recyclables)	$233	$134	$122	$142	$177
Residential Collection Costs per Tonne: (of Residential Recyclables)	$334	$190	$196	$263	$307
Total Net System Cost per Tonne: (of Total Recyclables)	$265	$136	$102	$128	$160
Total Net System Cost per Tonne - All Wastes (Excluding ICI Collection Costs)	$35	$16	$11	$15	$19
Total Net System Cost per Household - All Wastes (Excluding ICI Collection Costs)	$56	$35	$24	$26	$36

Note: All costs and tonnages are annual estimates based on Year 1991.

Table C4
Recycling System Options - Costs

Option: **BASE CASE #4**

Residential System: **Drop-off Depot**
Vehicles: **Roll-off Container Truck**
Diversion: **3%**

ICI System: **Self-Delivery**
Vehicles: **1/2, 1, and 3 Ton Trucks**
Diversion: **5%**

	CPFSA1	*CPFSA2*	*CPFSA3*	*CPFSA4*	*CPFSA5*
Households:	31,462	34,900	62,291	59,205	55,656
Residential Waste Tonnage:	28,925	41,374	71,826	45,743	51,817
ICI Waste Tonnage:	21,042	34,112	71,165	54,101	56,484
Total Waste Tonnage:	49,967	75,486	142,991	99,844	108,301
Residential Recyclables Tonnage:	868	1,241	2,155	1,372	1,555
ICI Recyclables Tonnage:	1,052	1,706	3,558	2,705	2,823
Total Recyclables Tonnage:	1,920	2,947	5,713	4,077	4,378
Plant Capital Costs:	$145,058	$145,058	$145,058	$145,058	$145,058
Plant Operations Costs:	$265,000	$341,405	$358,475	$341,405	$341,405
Total Plant Costs:	$410,058	$486,463	$503,533	$486,463	$486,463
Residential Collection Costs:	$2,147,510	$1,522,310	$3,105,750	$2,832,630	$3,077,150
ICI Collection Costs:	$255,750	$204,910	$359,250	$278,530	$490,460
Total Collection Costs:	$2,403,260	$1,727,220	$3,465,000	$3,111,160	$3,567,610

Note: All costs and tonnages are annual estimates based on Year 1991.

Table C4 (cont'd)
Recycling System Options - Costs

Option: **BASE CASE #4**

Residential System: **Drop-off Depot**
Vehicles: **Roll-off Container Truck**
Diversion: **3%**

ICI System: **Self-Delivery**
Vehicles: **1/2, 1, and 3 Ton Trucks**
Diversion: **5%**

	CPFSA1	*CPFSA2*	*CPFSA3*	*CPFSA4*	*CPFSA5*
Total System Costs:	$2,813,318	$2,213,683	$3,968,533	$3,597,623	$4,054,073
Total System Costs: (excluding ICI collection)	$2,557,568	$2,008,773	$3,609,283	$3,319,093	$3,563,613
Total Recyclables Revenue:	$120,880	$187,364	$368,236	$266,104	$284,136
Total Net System Costs:	$2,692,438	$2,026,319	$3,600,297	$3,331,519	$3,769,937
Total Net System Costs: (Excluding ICI Collection Costs)	$2,436,688	$1,821,409	$3,241,047	$3,052,989	$3,279,477
Plant Costs per Tonne: (of Total Recyclables)	$214	$165	$88	$119	$111
Net Plant Costs per Tonne: (of Total Recyclables)	$151	$101	$24	$54	$46
Collection Costs per Tonne: (of Total Recyclables)	$1,252	$586	$607	$763	$815
Residential Collection Costs per Tonne: (of Residential Recyclables)	$2,475	$1,226	$1,441	$2,064	$1,979
Total Net System Cost per Tonne: (of Total Recyclables)	$1,402	$688	$630	$817	$861
Total Net System Cost per Tonne - All Wastes (Excluding ICI Collection Costs)	$49	$24	$23	$31	$30
Total Net System Cost per Household - All Wastes (Excluding ICI Collection Costs)	$77	$52	$52	$52	$59

Note: All costs and tonnages are annual estimates based on Year 1991.

Table C5
Recycling System Options - Costs

Option:	**BASE CASE #5**
Residential System:	**Maximized Wet-Dry Recycling - Wheeled Containers**
Vehicles:	**SDRV (2 Compartments)**
Diversion:	**60%**
ICI System:	**Pick-Up Service/Self-Delivery**
Vehicles:	**Roll-Off Truck, Cube Van, Packer (FL)/½, 1, 3 Ton Trucks**
Diversion:	**66%**

	CPFSA1	*CPFSA2*	*CPFSA3*	*CPFSA4*	*CPFSA5*
Households:	31,462	34,900	62,291	59,205	55,656
Residential Waste Tonnage:	28,925	41,374	71,826	45,743	51,817
ICI Waste Tonnage:	21,042	34,112	71,165	54,101	56,484
Total Waste Tonnage:	49,967	75,486	142,991	99,844	108,301
Residential Recyclables Tonnage:	17,355	24,824	43,096	27,446	31,090
ICI Recyclables Tonnage:	13,888	22,514	46,969	35,707	37,279
Total Recyclables Tonnage:	31,243	47,338	90,065	63,152	68,370
Plant Capital Costs:	$1,217,748	$1,217,748	$3,362,473	$1,485,506	$3,362,473
Plant Operations Costs:	$1,793,433	$2,078,975	$3,532,959	$2,892,559	$3,313,473
Total Plant Costs:	$3,011,181	$3,296,723	$6,895,432	$4,378,065	$6,675,946
Residential Collection Costs:	$3,437,650	$2,568,630	$4,817,440	$3,754,090	$6,038,810
ICI Collection Costs:	$1,781,450	$1,788,270	$3,582,160	$2,641,230	$4,740,980
Total Collection Costs:	$5,219,100	$4,356,900	$8,399,600	$6,395,320	$10,779,790

Note: All costs and tonnages are annual estimates based on Year 1991.

Table C5 (cont'd)
Recycling System Options - Costs

Option: **BASE CASE #5**

Residential System: **Maximized Wet-Dry Recycling - Wheeled Containers**
Vehicles: **SDRV (2 Compartments)**
Diversion: **60%**

ICI System: **Pick-Up Service/Self-Delivery**
Vehicles: **Roll-Off Truck, Cube Van, Packer (FL)/½, 1, 3 Ton Trucks**
Diversion: **66%**

	CPFSA1	*CPFSA2*	*CPFSA3*	*CPFSA4*	*CPFSA5*
Total System Costs:	**$8,230,281**	**$7,653,623**	**$15,295,032**	**$10,773,385**	**$17,455,736**
Total System Costs: (excluding ICI collection)	**$6,448,831**	**$5,865,353**	**$11,712,872**	**$8,132,155**	**$12,714,756**
Total Recyclables Revenue:	$1,217,424	$1,850,318	$3,536,499	$2,490,611	$2,690,975
Total Net System Costs:	$7,012,857	$5,803,305	$11,758,533	$8,282,774	$14,764,761
Total Net System Costs: (Excluding ICI Collection Costs)	$5,231,407	$4,015,035	$8,176,373	$5,641,544	$10,023,781
Plant Costs per Tonne: (of Total Recyclables)	$96	$70	$77	$69	$98
Net Plant Costs per Tonne: (of Total Recyclables)	$57	$31	$37	$30	$58
Collection Costs per Tonne: (of Total Recyclables)	$167	$92	$93	$101	$158
Residential Collection Costs per Tonne: (of Residential Recyclables)	$198	$103	$112	$137	$194
Total Net System Cost per Tonne: (of Total Recyclables)	$224	$123	$131	$131	$216
Total Net System Cost per Tonne - All Wastes (Excluding ICI Collection Costs)	$105	$53	$57	$57	$93
Total Net System Cost per Household All Wastes (Excluding ICI Collection Costs)	$166	$115	$131	$95	$180

Note: All costs and tonnages are annual estimates based on Year 1991.

Table C6
Recycling System Options - Costs

Option: **SENSITIVITY TEST #1**

Residential System: **Roadside Collection - Blue Box**
Vehicles: **SDRV (ML)**
Diversion: **15%**

ICI System: **Pick-Up Service**
Vehicles: **Roll-off Truck, Cube Van**
Diversion: **25%**

	CPFSA1	*CPFSA2*	*CPFSA3*	*CPFSA4*	*CPFSA5*
Households:	31,462	34,900	62,291	59,205	55,656
Residential Waste Tonnage:	28,925	41,374	71,826	45,743	51,817
ICI Waste Tonnage:	21,042	34,112	71,165	54,101	56,484
Total Waste Tonnage:	49,967	75,486	142,991	99,844	108,301
Residential Recyclables Tonnage:	4,339	6,206	10,774	6,861	7,773
ICI Recyclables Tonnage:	5,261	8,528	17,791	13,524	14,120
Total Recyclables Tonnage:	9,599	14,734	28,565	20,386	21,893
Plant Capital Costs:	$397,620	$397,620	$397,620	$397,620	$397,620
Plant Operations Costs:	$518,620	$567,550	$855,347	$638,444	$655,409
Total Plant Costs:	$916,240	$965,170	$1,252,967	$1,036,064	$1,053,029
Residential Collection Costs:	$1,485,670	$1,227,760	$2,198,840	$1,894,300	$2,531,770
ICI Collection Costs:	$786,510	$790,870	$1,388,640	$1,093,240	$1,486,980
Total Collection Costs:	$2,272,180	$2,018,630	$3,587,480	$2,987,540	$4,018,750

Note: All costs and tonnages are annual estimates based on Year 1991.

Table C6 (cont'd)
Recycling System Options - Costs

Option: **SENSITIVITY TEST #1**

Residential System: **Roadside Collection - Blue Box**
Vehicles: **SDRV (ML)**
Diversion: **15%**

ICI System: **Pick-Up Service**
Vehicles: **Roll-off Truck, Cube Van**
Diversion: **25%**

	CPFSA1	*CPFSA2*	*CPFSA3*	*CPFSA4*	*CPFSA5*
Total System Costs:	$3,188,420	$2,983,800	$4,840,447	$4,023,604	$5,071,779
Total System Costs: (excluding ICI collection)	$2,401,910	$2,192,930	$3,451,807	$2,930,364	$3,584,799
Total Recyclables Revenue:	$604,348	$936,728	$1,841,200	$1,330,572	$1,420,856
Total Net System Costs:	$2,584,072	$2,047,072	$2,999,247	$2,693,032	$3,650,923
Total Net System Costs: (Excluding ICI Collection Costs)	$1,797,562	$1,256,202	$1,610,607	$1,599,792	$2,163,943
Plant Costs per Tonne: (of Total Recyclables)	$95	$66	$44	$51	$48
Net Plant Costs per Tonne: (of Total Recyclables)	$32	$2	($21)	($14)	($17)
Collection Costs per Tonne: (of Total Recyclables)	$237	$137	$126	$147	$184
Residential Collection Costs per Tonne: (of Residential Recyclables)	$342	$198	$204	$276	$326
Total Net System Cost per Tonne: (of Total Recyclables)	$269	$139	$105	$132	$167
Total Net System Cost per Tonne - All Wastes (Excluding ICI Collection Costs)	$36	$17	$11	$16	$20
Total Net System Cost per Household All Wastes (Excluding ICI Collection Costs)	$57	$36	$26	$27	$39

Note: All costs and tonnages are annual estimates based on Year 1991.

Table C7
Recycling System Options - Costs

Option: **SENSITIVITY TEST #2**

Residential System: **Roadside Collection - Blue Box**
Vehicles: **Cube Van**
Diversion: **15%**

ICI System: **Pick-Up Service**
Vehicles: **Roll-off Truck, Cube Van**
Diversion: **25%**

	CPFSA1	*CPFSA2*	*CPFSA3*	*CPFSA4*	*CPFSA5*
Households:	31,462	34,900	62,291	59,205	55,656
Residential Waste Tonnage:	28,925	41,374	71,826	45,743	51,817
ICI Waste Tonnage:	21,042	34,112	71,165	54,101	56,484
Total Waste Tonnage:	49,967	75,486	142,991	99,844	108,301
Residential Recyclables Tonnage:	4,339	6,206	10,774	6,861	7,773
ICI Recyclables Tonnage:	5,261	8,528	17,791	13,524	14,120
Total Recyclables Tonnage:	9,599	14,734	28,565	20,386	21,893
Plant Capital Costs:	$397,620	$397,620	$397,620	$397,620	$397,620
Plant Operations Costs:	$518,620	$567,550	$855,347	$638,444	$655,409
Total Plant Costs:	$916,240	$965,170	$1,252,967	$1,036,064	$1,053,029
Residential Collection Costs:	$1,826,890	$1,543,430	$2,754,040	$2,237,170	$3,206,780
ICI Collection Costs:	$786,510	$790,870	$1,388,640	$1,093,240	$1,486,980
Total Collection Costs:	$2,613,400	$2,334,300	$4,142,680	$3,330,410	$4,693,760

Note: All costs and tonnages are annual estimates based on Year 1991.

Table C7 (cont'd)
Recycling System Options - Costs

Option: **SENSITIVITY TEST #2**

Residential System: **Roadside Collection - Blue Box**
Vehicles: **Cube Van**
Diversion: **15%**

ICI System: **Pick-Up Service**
Vehicles: **Roll-off Truck, Cube Van**
Diversion: **25%**

	CPFSA1	*CPFSA2*	*CPFSA3*	*CPFSA4*	*CPFSA5*
Total System Costs:	$3,529,640	$3,299,470	$5,395,647	$4,366,474	$5,746,789
Total System Costs: (excluding ICI collection)	$2,743,130	$2,508,600	$4,007,007	$3,273,234	$4,259,809
Total Recyclables Revenue:	$604,348	$936,728	$1,841,200	$1,330,572	$1,420,856
Total Net System Costs:	$2,925,292	$2,362,742	$3,554,447	$3,035,902	$4,325,933
Total Net System Costs: (Excluding ICI Collection Costs)	$2,138,782	$1,571,872	$2,165,807	$1,942,662	$2,838,953
Plant Costs per Tonne: (of Total Recyclables)	$95	$66	$44	$51	$48
Net Plant Costs per Tonne: (of Total Recyclables)	$32	$2	($21)	($14)	($17)
Collection Costs per Tonne: (of Total Recyclables)	$272	$158	$145	$163	$214
Residential Collection Costs per Tonne: (of Residential Recyclables)	$421	$249	$256	$326	$413
Total Net System Cost per Tonne: (of Total Recyclables)	$305	$160	$124	$149	$198
Total Net System Cost per Tonne - All Wastes (Excluding ICI Collection Costs)	$43	$21	$15	$19	$26
Total Net System Cost per Household All Wastes (Excluding ICI Collection Costs)	$68	$45	$35	$33	$51

Note: All costs and tonnages are annual estimates based on Year 1991.

Table C8
Recycling System Options - Costs

Option:	**SENSITIVITY TEST #3**
Residential System:	**Roadside Collection - Blue Box**
Vehicles:	**1/2 Ton Truck with Trailer**
Diversion:	**15%**
ICI System:	**Pick-Up Service**
Vehicles:	**Roll-off Truck, Cube Van**
Diversion:	**25%**

	CPFSA1	*CPFSA2*	*CPFSA3*	*CPFSA4*	*CPFSA5*
Households:	31,462	34,900	62,291	59,205	55,656
Residential Waste Tonnage:	28,925	41,374	71,826	45,743	51,817
ICI Waste Tonnage:	21,042	34,112	71,165	54,101	56,484
Total Waste Tonnage:	49,967	75,486	142,991	99,844	108,301
Residential Recyclables Tonnage:	4,339	6,206	10,774	6,861	7,773
ICI Recyclables Tonnage:	5,261	8,528	17,791	13,524	14,120
Total Recyclables Tonnage:	9,599	14,734	28,565	20,386	21,893
Plant Capital Costs:	$397,620	$397,620	$397,620	$397,620	$397,620
Plant Operations Costs:	$518,620	$567,550	$855,347	$638,444	$655,409
Total Plant Costs:	$916,240	$965,170	$1,252,967	$1,036,064	$1,053,029
Residential Collection Costs:	$1,867,560	$1,499,670	$2,697,370	$2,298,460	$3,215,820
ICI Collection Costs:	$786,510	$790,870	$1,388,640	$1,093,240	$1,486,980
Total Collection Costs:	$2,654,070	$2,290,540	$4,086,010	$3,391,700	$4,702,800

Note: All costs and tonnages are annual estimates based on Year 1991.

Table C8 (cont'd)
Recycling System Options - Costs

Option: **SENSITIVITY TEST #3**

Residential System: **Roadside Collection - Blue Box**
Vehicles: **1/2 Ton Truck with Trailer**
Diversion: **15%**

ICI System: **Pick-Up Service**
Vehicles: **Roll-off Truck, Cube Van**
Diversion: **25%**

	CPFSA1	*CPFSA2*	*CPFSA3*	*CPFSA4*	*CPFSA5*
Total System Costs:	**$3,570,310**	**$3,255,710**	**$5,338,977**	**$4,427,764**	**$5,755,829**
Total System Costs: (excluding ICI collection)	**$2,783,800**	**$2,464,840**	**$3,950,337**	**$3,334,524**	**$4,268,849**
Total Recyclables Revenue:	$604,348	$936,728	$1,841,200	$1,330,572	$1,420,856
Total Net System Costs:	$2,965,962	$2,318,982	$3,497,777	$3,097,192	$4,334,973
Total Net System Costs: (Excluding ICI Collection Costs)	$2,179,452	$1,528,112	$2,109,137	$2,003,952	$2,847,993
Plant Costs per Tonne: (of Total Recyclables)	$95	$66	$44	$51	$48
Net Plant Costs per Tonne: (of Total Recyclables)	$32	$2	($21)	($14)	($17)
Collection Costs per Tonne: (of Total Recyclables)	$276	$155	$143	$166	$215
Residential Collection Costs per Tonne: (of Residential Recyclables)	$430	$242	$250	$335	$414
Total Net System Cost per Tonne: (of Total Recyclables)	$309	$157	$122	$152	$198
Total Net System Cost per Tonne - All Wastes (Excluding ICI Collection Costs)	$44	$20	$15	$20	$26
Total Net System Cost per Household All Wastes (Excluding ICI Collection Costs)	$69	$44	$34	$34	$51

Note: All costs and tonnages are annual estimates based on Year 1991.

Table C9
Recycling System Options - Costs

Option: **SENSITIVITY TEST #4**

Residential System: **Roadside Collection - Blue Box**
Vehicles: **Packer (SL) with Trailer**
Diversion: **15 % (all other waste collected in packer)**

ICI System: **Pick-Up Service**
Vehicles: **Roll-off Truck, Cube Van**
Diversion: **25%**

	CPFSA1	*CPFSA2*	*CPFSA3*	*CPFSA4*	*CPFSA5*
Households:	31,462	34,900	62,291	59,205	55,656
Residential Waste Tonnage:	28,925	41,374	71,826	45,743	51,817
ICI Waste Tonnage:	21,042	34,112	71,165	54,101	56,484
Total Waste Tonnage:	49,967	75,486	142,991	99,844	108,301
Residential Recyclables Tonnage:	4,339	6,206	10,774	6,861	7,773
ICI Recyclables Tonnage:	5,261	8,528	17,791	13,524	14,120
Total Recyclables Tonnage:	9,599	14,734	28,565	20,386	21,893
Plant Capital Costs:	$397,620	$397,620	$397,620	$397,620	$397,620
Plant Operations Costs:	$518,620	$567,550	$855,347	$638,444	$655,409
Total Plant Costs:	$916,240	$965,170	$1,252,967	$1,036,064	$1,053,029
Residential Collection Costs:	$3,927,970	$3,431,240	$5,969,130	$5,218,680	$6,639,780
ICI Collection Costs:	$786,510	$790,870	$1,388,640	$1,093,240	$1,486,980
Total Collection Costs:	$4,714,480	$4,222,110	$7,357,770	$6,311,920	$8,126,760

Note: All costs and tonnages are annual estimates based on Year 1991.

Table C9 (cont'd)

Recycling System Options - Costs

Option: **SENSITIVITY TEST #4**

Residential System: **Roadside Collection - Blue Box**
Vehicles: **Packer (SL) with Trailer**
Diversion: **15 % (all other waste collected in packer)**

ICI System: **Pick-Up Service**
Vehicles: **Roll-off Truck, Cube Van**
Diversion: **25%**

	CPFSA1	*CPFSA2*	*CPFSA3*	*CPFSA4*	*CPFSA5*
Total System Costs:	$5,630,720	$5,187,280	$8,610,737	$7,347,984	$9,179,789
Total System Costs: (excluding ICI collection)	$4,844,210	$4,396,410	$7,222,097	$6,254,744	$7,692,809
Total Recyclables Revenue:	$604,348	$936,728	$1,841,200	$1,330,572	$1,420,856
Total Net System Costs:	$5,026,372	$4,250,552	$6,769,537	$6,017,412	$7,758,933
Total Net System Costs: (Excluding ICI Collection Costs)	$4,239,862	$3,459,682	$5,380,897	$4,924,172	$6,271,953
Plant Costs per Tonne: (of Total Recyclables)	$95	$66	$44	$51	$48
Net Plant Costs per Tonne: (of Total Recyclables)	$32	$2	($21)	($14)	($17)
Collection Costs per Tonne: (of Total Recyclables)	$491	$287	$258	$310	$371
Residential Collection Costs per Tonne: (of Residential Recyclables)	$905	$553	$554	$761	$854
Total Net System Cost per Tonne: (of Total Recyclables)	$524	$288	$237	$295	$354
Total Net System Cost per Tonne - All Wastes (Excluding ICI Collection Costs)	$85	$46	$38	$49	$58
Total Net System Cost per Household All Wastes (Excluding ICI Collection Costs)	$135	$99	$86	$83	$113

Note: All costs and tonnages are annual estimates based on Year 1991.

Table C10
Recycling System Options - Costs

Option: **SENSITIVITY TEST #5**

Residential System: **Roadside Collection - Blue Bag**
Vehicles: **Packer (RL)**
Diversion: **15%**

ICI System: **Pick-Up Service**
Vehicles: **Roll-off Truck, Cube Van**
Diversion: **25%**

	CPFSA1	*CPFSA2*	*CPFSA3*	*CPFSA4*	*CPFSA5*
Households:	31,462	34,900	62,291	59,205	55,656
Residential Waste Tonnage:	28,925	41,374	71,826	45,743	51,817
ICI Waste Tonnage:	21,042	34,112	71,165	54,101	56,484
Total Waste Tonnage:	49,967	75,486	142,991	99,844	108,301
Residential Recyclables Tonnage:	4,339	6,206	10,774	6,861	7,773
ICI Recyclables Tonnage:	5,261	8,528	17,791	13,524	14,120
Total Recyclables Tonnage:	9,599	14,734	28,565	20,386	21,893
Plant Capital Costs:	$397,620	$397,620	$397,620	$397,620	$397,620
Plant Operations Costs:	$518,620	$567,550	$855,347	$638,444	$655,409
Total Plant Costs:	$916,240	$965,170	$1,252,967	$1,036,064	$1,053,029
Residential Collection Costs:	$1,709,297	$1,387,630	$2,475,480	$2,113,760	$2,791,415
ICI Collection Costs:	$786,510	$790,870	$1,388,640	$1,093,240	$1,486,980
Total Collection Costs:	$2,495,807	$2,178,500	$3,864,120	$3,207,000	$4,278,395

Note: All costs and tonnages are annual estimates based on Year 1991.

Table C10 (cont'd)
Recycling System Options - Costs

Option: **SENSITIVITY TEST #5**

Residential System: **Roadside Collection - Blue Bag**
Vehicles: **Packer (RL)**
Diversion: **15%**

ICI System: **Pick-Up Service**
Vehicles: **Roll-off Truck, Cube Van**
Diversion: **25%**

	CPFSA1	*CPFSA2*	*CPFSA3*	*CPFSA4*	*CPFSA5*
Total System Costs:	$3,412,047	$3,143,670	$5,117,087	$4,243,064	$5,331,424
Total System Costs: (excluding ICI collection)	$2,625,537	$2,352,800	$3,728,447	$3,149,824	$3,844,444
Total Recyclables Revenue:	$604,348	$936,728	$1,841,200	$1,330,572	$1,420,856
Total Net System Costs:	$2,807,699	$2,206,942	$3,275,887	$2,912,492	$3,910,568
Total Net System Costs: (Excluding ICI Collection Costs)	$2,021,189	$1,416,072	$1,887,247	$1,819,252	$2,423,588
Plant Costs per Tonne: (of Total Recyclables)	$95	$66	$44	$51	$48
Net Plant Costs per Tonne: (of Total Recyclables)	$32	$2	($21)	($14)	($17)
Collection Costs per Tonne: (of Total Recyclables)	$260	$148	$135	$157	$195
Residential Collection Costs per Tonne: (of Residential Recyclables)	$394	$224	$230	$308	$359
Total Net System Cost per Tonne: (of Total Recyclables)	$292	$150	$115	$143	$179
Total Net System Cost per Tonne - All Wastes (Excluding ICI Collection Costs)	$40	$19	$13	$18	$22
Total Net System Cost per Household All Wastes (Excluding ICI Collection Costs)	$64	$41	$30	$31	$44

Note: All costs and tonnages are annual estimates based on Year 1991.

Table C11
Recycling System Options - Costs

Option: **SENSITIVITY TEST #6**

Residential System: **Bi-weekly Roadside Collection - Blue Box**
Vehicles: **SDRV (PL)**
Diversion: **13.2% (Reduced Participation)**

ICI System: **Pick-Up Service**
Vehicles: **Roll-off Truck, Cube Van**
Diversion: **25%**

	CPFSA1	*CPFSA2*	*CPFSA3*	*CPFSA4*	*CPFSA5*
Households:	31,462	34,900	62,291	59,205	55,656
Residential Waste Tonnage:	28,925	41,374	71,826	45,743	51,817
ICI Waste Tonnage:	21,042	34,112	71,165	54,101	56,484
Total Waste Tonnage:	49,967	75,486	142,991	99,844	108,301
Residential Recyclables Tonnage:	3,818	5,461	9,481	6,038	6,840
ICI Recyclables Tonnage:	5,260	8,528	17,791	13,525	14,121
Total Recyclables Tonnage:	9,078	13,989	27,272	19,563	20,961
Plant Capital Costs:	$397,620	$397,620	$397,620	$397,620	$397,620
Plant Operations Costs:	$518,620	$567,550	$855,347	$638,444	$655,409
Total Plant Costs:	$916,240	$965,170	$1,252,967	$1,036,064	$1,053,029
Residential Collection Costs:	$1,222,830	$1,069,760	$1,909,720	$1,689,030	$2,096,310
ICI Collection Costs:	$786,510	$790,870	$1,388,640	$1,093,240	$1,486,980
Total Collection Costs:	$2,009,340	$1,860,630	$3,298,360	$2,782,270	$3,583,290

Note: All costs and tonnages are annual estimates based on Year 1991.

Table C11 (cont'd)
Recycling System Options - Costs

Option: **SENSITIVITY TEST #6**

Residential System: **Bi-weekly Roadside Collection - Blue Box**
Vehicles: **SDRV (PL)**
Diversion: **13.2% (Reduced Participation)**

ICI System: **Pick-Up Service**
Vehicles: **Roll-off Truck, Cube Van**
Diversion: **25%**

	CPFSA1	*CPFSA2*	*CPFSA3*	*CPFSA4*	*CPFSA5*
Total System Costs:	$2,925,580	$2,825,800	$4,551,327	$3,818,334	$4,636,319
Total System Costs: (excluding ICI collection)	$2,139,070	$2,034,930	$3,162,687	$2,725,094	$3,149,339
Total Recyclables Revenue:	$577,273	$898,003	$1,773,970	$1,287,759	$1,372,359
Total Net System Costs:	$2,348,307	$1,927,797	$2,777,357	$2,530,575	$3,263,960
Total Net System Costs: (Excluding ICI Collection Costs)	$1,561,797	$1,136,927	$1,388,717	$1,437,335	$1,776,980
Plant Costs per Tonne: (of Total Recyclables)	$101	$69	$46	$53	$50
Net Plant Costs per Tonne: (of Total Recyclables)	$37	$5	($19)	($13)	($15)
Collection Costs per Tonne: (of Total Recyclables)	$221	$133	$121	$142	$171
Residential Collection Costs per Tonne: (of Residential Recyclables)	$320	$196	$201	$280	$306
Total Net System Cost per Tonne: (of Total Recyclables)	$259	$138	$102	$129	$156
Total Net System Cost per Tonne - All Wastes (Excluding ICI Collection Costs)	$31	$15	$10	$14	$16
Total Net System Cost per Household All Wastes (Excluding ICI Collection Costs)	$50	$33	$22	$24	$32

Note: All costs and tonnages are annual estimates based on Year 1991.

Table C12
Recycling System Options - Costs

Option: **SENSITIVITY TEST #7**

Residential System: **Monthly Roadside Collection - Blue Box**
Vehicles: **SDRV (PL)**
Diversion: **12.2% (Reduced Participation)**

ICI System: **Pick-Up Service**
Vehicles: **Roll-off Truck, Cube Van**
Diversion: **25%**

	CPFSA1	*CPFSA2*	*CPFSA3*	*CPFSA4*	*CPFSA5*
Households:	31,462	34,900	62,291	59,205	55,656
Residential Waste Tonnage:	28,925	41,374	71,826	45,743	51,817
ICI Waste Tonnage:	21,042	34,112	71,165	54,101	56,484
Total Waste Tonnage:	49,967	75,486	142,991	99,844	108,301
Residential Recyclables Tonnage:	3,529	5,048	8,763	5,581	6,322
ICI Recyclables Tonnage:	5,261	8,528	17,791	13,525	14,121
Total Recyclables Tonnage:	8,789	13,576	26,554	19,106	20,443
Plant Capital Costs:	$397,620	$397,620	$397,620	$397,620	$397,620
Plant Operations Costs:	$518,620	$567,550	$855,347	$638,444	$655,409
Total Plant Costs:	$916,240	$965,170	$1,252,967	$1,036,064	$1,053,029
Residential Collection Costs:	$1,083,460	$991,160	$1,723,280	$1,519,500	$1,882,660
ICI Collection Costs:	$786,510	$790,870	$1,388,640	$1,093,240	$1,486,980
Total Collection Costs:	$1,869,970	$1,782,030	$3,111,920	$2,612,740	$3,369,640

Note: All costs and tonnages are annual estimates based on Year 1991.

Table C12 (cont'd)
Recycling System Options - Costs

Option: **SENSITIVITY TEST #7**

Residential System: **Monthly Roadside Collection - Blue Box**
Vehicles: **SDRV (PL)**
Diversion: **12.2% (Reduced Participation)**

ICI System: **Pick-Up Service**
Vehicles: **Roll-off Truck, Cube Van**
Diversion: **25%**

	CPFSA1	*CPFSA2*	*CPFSA3*	*CPFSA4*	*CPFSA5*
Total System Costs:	**$2,786,210**	**$2,747,200**	**$4,364,887**	**$3,648,804**	**$4,422,669**
Total System Costs: (excluding ICI collection)	**$1,999,700**	**$1,956,330**	**$2,976,247**	**$2,555,564**	**$2,935,689**
Total Recyclables Revenue:	$562,231	$876,488	$1,736,620	$1,263,975	$1,345,416
Total Net System Costs:	$2,223,979	$1,870,712	$2,628,267	$2,384,829	$3,077,253
Total Net System Costs: (Excluding ICI Collection Costs)	$1,437,469	$1,079,842	$1,239,627	$1,291,589	$1,590,273
Plant Costs per Tonne: (of Total Recyclables)	$104	$71	$47	$54	$52
Net Plant Costs per Tonne: (of Total Recyclables)	$40	$7	($18)	($12)	($14)
Collection Costs per Tonne: (of Total Recyclables)	$213	$131	$117	$137	$165
Residential Collection Costs per Tonne: (of Residential Recyclables)	$307	$196	$197	$272	$298
Total Net System Cost per Tonne: (of Total Recyclables)	$253	$138	$99	$125	$151
Total Net System Cost per Tonne - All Wastes (Excluding ICI Collection Costs)	$29	$14	$9	$13	$15
Total Net System Cost per Household All Wastes (Excluding ICI Collection Costs)	$46	$31	$20	$22	$29

Note: All costs and tonnages are annual estimates based on Year 1991.

Table C13
Recycling System Options - Costs

Option: **SENSITIVITY TEST #8**

Residential System: **Urban Roadside Collection - Blue Box**
Vehicles: **SDRV (PL)**
Diversion: **15% (of Urban Areas Only)**

ICI System: **Pick-Up Service**
Vehicles: **Roll-off Truck, Cube Van**
Diversion: **25% (of Urban Areas Only)**

	CPFSA1	*CPFSA2*	*CPFSA3*	*CPFSA4*	*CPFSA5*
Households:	9,399	21,945	41,728	29,791	15,489
Residential Waste Tonnage:	8,448	25,179	51,487	22,874	12,490
ICI Waste Tonnage:	6,048	20,759	54,142	29,113	16,333
Total Waste Tonnage:	14,496	45,938	105,629	51,987	28,824
Residential Recyclables Tonnage:	1,267	3,777	7,723	3,431	1,874
ICI Recyclables Tonnage:	1,512	5,190	13,536	7,278	4,082
Total Recyclables Tonnage:	2,779	8,967	21,259	10,709	5,956
Plant Capital Costs:	$145,058	$379,620	$397,620	$397,620	$145,058
Plant Operations Costs:	$341,405	$518,620	$767,488	$522,000	$358,475
Total Plant Costs:	$486,463	$898,240	$1,165,108	$919,620	$503,533
Residential Collection Costs:	$280,210	$573,940	$1,039,170	$402,010	$536,990
ICI Collection Costs:	$149,340	$299,930	$722,650	$346,600	$354,540
Total Collection Costs:	$429,550	$873,870	$1,761,820	$748,610	$891,530

Note: All costs and tonnages are annual estimates based on Year 1991.

Table C13 (cont'd)
Recycling System Options - Costs

Option: **SENSITIVITY TEST #8**

Residential System: **Urban Roadside Collection - Blue Box**
Vehicles: **SDRV (PL)**
Diversion: **15% (of Urban Areas Only)**

ICI System: **Pick-Up Service**
Vehicles: **Roll-off Truck, Cube Van**
Diversion: **25% (of Urban Areas Only)**

	CPFSA1	*CPFSA2*	*CPFSA3*	*CPFSA4*	*CPFSA5*
Total System Costs:	$916,013	$1,772,110	$2,926,928	$1,668,230	$1,395,063
Total System Costs: (excluding ICI collection)	$766,673	$1,472,180	$2,204,278	$1,321,630	$1,040,523
Total Recyclables Revenue:	$174,748	$570,084	$1,376,188	$702,428	$428,832
Total Net System Costs:	$741,265	$1,202,026	$1,550,740	$965,802	$966,231
Total Net System Costs: (Excluding ICI Collection Costs)	$591,925	$902,096	$828,090	$619,202	$611,691
Plant Costs per Tonne: (of Total Recyclables)	$175	$100	$55	$86	$85
Net Plant Costs per Tonne: (of Total Recyclables)	$112	$37	($10)	$20	$13
Collection Costs per Tonne: (of Total Recyclables)	$155	$97	$83	$70	$150
Residential Collection Costs per Tonne: (of Residential Recyclables)	$221	$152	$135	$117	$287
Total Net System Cost per Tonne: (of Total Recyclables)	$267	$134	$73	$90	$162
Total Net System Cost per Tonne - All Wastes (Excluding ICI Collection Costs)	$41	$20	$8	$12	$21
Total Net System Cost per Household All Wastes (Excluding ICI Collection Costs)	$63	$41	$20	$21	$39

Note: All costs and tonnages are annual estimates based on Year 1991.

Table C14
Recycling System Options - Costs

Option: **SENSITIVITY TEST #9**

Residential System: **Rural Depots/Urban Collection**
Vehicles: **Roll-off Truck/SDRV (PL)**
Diversion: **3% (Rural Areas)/15% (Urban Areas)**

ICI System: **Rural Self-Delivery/Urban Pick-up Service**
Vehicles: **1/2, 1, and 3 Ton Trucks/Roll-off Truck, Cube Van**
Diversion: **5% (Rural Areas)/25% (Urban Areas)**

	CPFSA1	*CPFSA2*	*CPFSA3*	*CPFSA4*	*CPFSA5*
Households:	31,462	34,900	62,291	59,205	55,656
Residential Waste Tonnage:	28,925	41,374	71,826	45,743	51,817
ICI Waste Tonnage:	21,042	34,112	71,165	54,101	56,484
Total Waste Tonnage:	49,967	75,486	142,991	99,844	108,301
Residential Recyclables Tonnage:	1,882	4,263	8,334	4,117	3,043
ICI Recyclables Tonnage:	2,261	5,858	14,384	8,527	6,101
Total Recyclables Tonnage:	4,143	10,121	22,718	12,644	9,144
Plant Capital Costs:	$145,058	$397,620	$397,620	$397,620	$397,620
Plant Operations Costs:	$341,405	$518,620	$767,488	$567,500	$518,620
Total Plant Costs:	$486,463	$916,240	$1,165,108	$965,120	$916,240
Residential Collection Costs:	$2,065,990	$1,373,130	$2,738,040	$2,466,910	$3,044,060
ICI Collection Costs:	$360,920	$443,490	$948,580	$571,020	$736,150
Total Collection Costs:	$2,426,910	$1,816,620	$3,686,620	$3,037,930	$3,780,210

Note: All costs and tonnages are annual estimates based on Year 1991.

Table C14 (cont'd)
Recycling System Options - Costs

Option: **SENSITIVITY TEST #9**

Residential System: **Rural Depots/Urban Collection**
Vehicles: **Roll-off Truck/SDRV (PL)**
Diversion: **3% (Rural Areas)/15% (Urban Areas)**

ICI System: **Rural Self-Delivery/Urban Pick-up Service**
Vehicles: **1/2, 1, and 3 Ton Trucks/Roll-off Truck, Cube Van**
Diversion: **5% (Rural Areas)/25% (Urban Areas)**

	CPFSA1	*CPFSA2*	*CPFSA3*	*CPFSA4*	*CPFSA5*
Total System Costs:	$2,913,373	$2,732,860	$4,851,728	$4,003,050	$4,696,450
Total System Costs: (excluding ICI collection)	$2,552,453	$2,289,370	$3,903,148	$3,432,030	$3,960,300
Total Recyclables Revenue:	$260,656	$643,452	$1,469,160	$828,028	$658,368
Total Net System Costs:	$2,652,717	$2,089,408	$3,382,568	$3,175,022	$4,038,082
Total Net System Costs: (Excluding ICI Collection Costs)	$2,291,797	$1,645,918	$2,433,988	$2,604,002	$3,301,932
Plant Costs per Tonne: (of Total Recyclables)	$117	$91	$51	$76	$100
Net Plant Costs per Tonne: (of Total Recyclables)	$55	$27	($13)	$11	$28
Collection Costs per Tonne: (of Total Recyclables)	$586	$179	$162	$240	$413
Residential Collection Costs per Tonne: (of Residential Recyclables)	$1,098	$322	$329	$599	$1,000
Total Net System Cost per Tonne: (of Total Recyclables)	$640	$206	$149	$251	$442
Total Net System Cost per Tonne - All Wastes (Excluding ICI Collection Costs)	$46	$22	$17	$26	$30
Total Net System Cost per Household All Wastes (Excluding ICI Collection Costs)	$73	$47	$39	$44	$59

Note: All costs and tonnages are annual estimates based on Year 1991.

Table C15
Recycling System Options - Costs

Option: **SENSITIVITY TEST #10**

Residential System: **Roadside Collection - Blue Box**
Vehicles: **SDRV (PL)**
Diversion: **25% (High Scenario)**

ICI System: **Pick-Up Service**
Vehicles: **Roll-off Truck, Cube Van**
Diversion: **35% (High Scenario)**

	CPFSA1	*CPFSA2*	*CPFSA3*	*CPFSA4*	*CPFSA5*
Households:	31,462	34,900	62,291	59,205	55,656
Residential Waste Tonnage:	28,925	41,374	71,826	45,743	51,817
ICI Waste Tonnage:	21,042	34,112	71,165	54,101	56,484
Total Waste Tonnage:	49,967	75,486	142,991	99,844	108,301
Residential Recyclables Tonnage:	7,231	10,344	17,957	11,436	12,954
ICI Recyclables Tonnage:	7,365	11,939	24,909	18,935	19,768
Total Recyclables Tonnage:	14,596	22,283	42,865	30,371	32,723
Plant Capital Costs:	$397,620	$397,620	$397,620	$397,620	$397,620
Plant Operations Costs:	$567,550	$767,488	$1,036,065	$879,312	$923,241
Total Plant Costs:	$965,170	$1,165,108	$1,433,685	$1,276,932	$1,320,861
Residential Collection Costs:	$1,659,060	$1,377,060	$2,381,960	$2,060,390	$2,817,020
ICI Collection Costs:	$912,960	$966,450	$1,769,070	$1,380,240	$1,902,890
Total Collection Costs:	$2,572,020	$2,343,510	$4,151,030	$3,440,630	$4,719,910

Note: All costs and tonnages are annual estimates based on Year 1991.

Table C15 (cont'd)
Recycling System Options - Costs

Option: **SENSITIVITY TEST #10**

Residential System: **Roadside Collection - Blue Box**
Vehicles: **SDRV (PL)**
Diversion: **25% (High Scenario)**

ICI System: **Pick-Up Service**
Vehicles: **Roll-off Truck, Cube Van**
Diversion: **35% (High Scenario)**

	CPFSA1	*CPFSA2*	*CPFSA3*	*CPFSA4*	*CPFSA5*
Total System Costs:	$3,537,190	$3,508,618	$5,584,715	$4,717,562	$6,040,771
Total System Costs: (excluding ICI collection)	$2,624,230	$2,542,168	$3,815,645	$3,337,322	$4,137,881
Total Recyclables Revenue:	$906,292	$1,397,496	$2,727,140	$1,957,992	$2,096,976
Total Net System Costs:	$2,630,898	$2,111,122	$2,857,575	$2,759,570	$3,943,795
Total Net System Costs: (Excluding ICI Collection Costs)	$1,717,938	$1,144,672	$1,088,505	$1,379,330	$2,040,905
Plant Costs per Tonne: (of Total Recyclables)	$66	$52	$33	$42	$40
Net Plant Costs per Tonne: (of Total Recyclables)	$4	($10)	($30)	($22)	($24
Collection Costs per Tonne: (of Total Recyclables)	$176	$105	$97	$113	$144
Residential Collection Costs per Tonne: (of Residential Recyclables)	$229	$133	$133	$180	$217
Total Net System Cost per Tonne: (of Total Recyclables)	$180	$95	$67	$91	$121
Total Net System Cost per Tonne - All Wastes (Excluding ICI Collection Costs)	$34	$15	$8	$14	$19
Total Net System Cost per Household All Wastes (Excluding ICI Collection Costs)	$55	$33	$17	$23	$37

Note: All costs and tonnages are annual estimates based on Year 1991.

Table C16
Recycling System Options - Costs

Option: **SENSITIVITY TEST #11**

Residential System: **Roadside Collection - Blue Box**
Vehicles: **SDRV (PL)**
Diversion: **10% (Low Scenario)**

ICI System: **Pick-Up Service**
Vehicles: **Roll-off Truck, Cube Van**
Diversion: **10% (Low Scenario)**

	CPFSA1	*CPFSA2*	*CPFSA3*	*CPFSA4*	*CPFSA5*
Households:	31,462	34,900	62,291	59,205	55,656
Residential Waste Tonnage:	28,925	41,374	71,826	45,743	51,817
ICI Waste Tonnage:	21,042	34,112	71,165	54,101	56,484
Total Waste Tonnage:	49,967	75,486	142,991	99,844	108,301
Residential Recyclables Tonnage:	2,893	4,136	7,208	4,574	5,182
ICI Recyclables Tonnage:	2,104	3,411	7,142	5,410	5,648
Total Recyclables Tonnage:	4,997	7,548	14,349	9,984	10,830
Plant Capital Costs:	$397,620	$397,620	$397,620	$397,620	$397,620
Plant Operations Costs:	$352,000	$367,000	$567,000	$516,000	$522,000
Total Plant Costs:	$749,620	$764,620	$964,620	$913,620	$919,620
Residential Collection Costs:	$1,433,350	$1,244,810	$2,193,330	$1,909,020	$2,372,160
ICI Collection Costs:	$594,210	$545,900	$856,760	$702,380	$914,680
Total Collection Costs:	$2,027,560	$1,790,710	$3,050,090	$2,611,400	$3,286,840

Note: All costs and tonnages are annual estimates based on Year 1991.

Table C16 (cont'd)
Recycling System Options - Costs

Option: **SENSITIVITY TEST #11**

Residential System: **Roadside Collection - Blue Box**
Vehicles: **SDRV (PL)**
Diversion: **10% (Low Scenario)**

ICI System: **Pick-Up Service**
Vehicles: **Roll-off Truck, Cube Van**
Diversion: **10% (Low Scenario)**

	CPFSA1	*CPFSA2*	*CPFSA3*	*CPFSA4*	*CPFSA5*
Total System Costs:	**$2,777,180**	**$2,555,330**	**$4,014,710**	**$3,525,020**	**$4,206,460**
Total System Costs: (excluding ICI collection)	**$2,182,970**	**$2,009,430**	**$3,157,950**	**$2,822,640**	**$3,291,780**
Total Recyclables Revenue:	$301,924	$460,716	$885,868	$627,368	$676,120
Total Net System Costs:	$2,475,256	$2,094,614	$3,128,842	$2,897,652	$3,530,340
Total Net System Costs: (Excluding ICI Collection Costs)	$1,881,046	$1,548,714	$2,272,082	$2,195,272	$2,615,660
Plant Costs per Tonne: (of Total Recyclables)	$150	$101	$67	$92	$85
Net Plant Costs per Tonne: (of Total Recyclables)	$90	$40	$5	$29	$22
Collection Costs per Tonne: (of Total Recyclables)	$406	$237	$213	$262	$303
Residential Collection Costs per Tonne: (of Residential Recyclables)	$496	$301	$304	$417	$458
Total Net System Cost per Tonne: (of Total Recyclables)	$495	$278	$218	$290	$326
Total Net System Cost per Tonne - All Wastes (Excluding ICI Collection Costs)	$38	$21	$16	$22	$24
Total Net System Cost per Household All Wastes (Excluding ICI Collection Costs)	$60	$44	$36	$37	$47

Note: All costs and tonnages are annual estimates based on Year 1991.

Table C17
Recycling System Options - Costs

Option: **SENSITIVITY TEST #12**

Residential System: **Roadside Collection - Blue Box**
Vehicles: **SDRV (PL)**
Diversion: **25% (High Scenario)**

ICI System: **Self-Delivery**
Vehicles: **1/2, 1, and 3 Ton Trucks**
Diversion: **20% (High Scenario)**

	CPFSA1	*CPFSA2*	*CPFSA3*	*CPFSA4*	*CPFSA5*
Households:	31,462	34,900	62,291	59,205	55,656
Residential Waste Tonnage:	28,925	41,374	71,826	45,743	51,817
ICI Waste Tonnage:	21,042	34,112	71,165	54,101	56,484
Total Waste Tonnage:	49,967	75,486	142,991	99,844	108,301
Residential Recyclables Tonnage:	7,231	10,344	17,957	11,436	12,954
ICI Recyclables Tonnage:	4,207	6,822	14,233	10,820	11,297
Total Recyclables Tonnage:	11,439	17,166	32,190	22,256	24,251
Plant Capital Costs:	$397,620	$397,620	$397,620	$397,620	$397,620
Plant Operations Costs:	$525,000	$685,000	$923,241	$767,488	$790,000
Total Plant Costs:	$922,620	$1,082,620	$1,320,861	$1,165,108	$1,187,620
Residential Collection Costs:	$1,659,060	$1,377,060	$2,381,960	$2,060,390	$2,817,020
ICI Collection Costs:	$562,910	$462,020	$810,020	$680,970	$1,205,010
Total Collection Costs:	$2,221,970	$1,839,080	$3,191,980	$2,741,360	$4,022,030

Note: All costs and tonnages are annual estimates based on Year 1991.

Table C17 (cont'd)
Recycling System Options - Costs

Option: **SENSITIVITY TEST #12**

Residential System: **Roadside Collection - Blue Box**
Vehicles: **SDRV (PL)**
Diversion: **25% (High Scenario)**

ICI System: **Self-Delivery**
Vehicles: **1/2, 1, and 3 Ton Trucks**
Diversion: **20% (High Scenario)**

	CPFSA1	*CPFSA2*	*CPFSA3*	*CPFSA4*	*CPFSA5*
Total System Costs:	**$3,144,590**	**$2,921,700**	**$4,512,841**	**$3,906,468**	**$5,209,650**
Total System Costs: (excluding ICI collection)	**$2,581,680**	**$2,459,680**	**$3,702,821**	**$3,225,498**	**$4,004,640**
Total Recyclables Revenue:	$678,988	$1,029,072	$1,958,540	$1,373,712	$1,486,992
Total Net System Costs:	$2,465,602	$1,892,628	$2,554,301	$2,532,756	$3,722,658
Total Net System Costs: (Excluding ICI Collection Costs)	$1,902,692	$1,430,608	$1,744,281	$1,851,786	$2,517,648
Plant Costs per Tonne: (of Total Recyclables)	$81	$63	$41	$52	$49
Net Plant Costs per Tonne: (of Total Recyclables)	$21	$3	($20)	($9)	($12)
Collection Costs per Tonne: (of Total Recyclables)	$194	$107	$99	$123	$166
Residential Collection Costs per Tonne: (of Residential Recyclables)	$229	$133	$133	$180	$217
Total Net System Cost per Tonne: (of Total Recyclables)	$216	$110	$79	$114	$154
Total Net System Cost per Tonne - All Wastes (Excluding ICI Collection Costs)	$38	$19	$12	$19	$23
Total Net System Cost per Household All Wastes (Excluding ICI Collection Costs)	$60	$41	$28	$31	$45

Note: All costs and tonnages are annual estimates based on Year 1991.

Table C18
Recycling System Options - Costs

Option: **SENSITIVITY TEST #13**

Residential System: **Roadside Collection - Blue Box**
Vehicles: **SDRV (PL)**
Diversion: **21% (Additional Group 1 Co-collected Materials)**

ICI System: **Pick-Up Service**
Vehicles: **Roll-off Truck, Cube Van, Packer (FL)**
Diversion: **39.15% (Additional Materials Collected)**

	CPFSA1	*CPFSA2*	*CPFSA3*	*CPFSA4*	*CPFSA5*
Households:	31,462	34,900	62,291	59,205	55,656
Residential Waste Tonnage:	28,925	41,374	71,826	45,743	51,817
ICI Waste Tonnage:	21,042	34,112	71,165	54,101	56,484
Total Waste Tonnage:	49,967	75,486	142,991	99,844	108,301
Residential Recyclables Tonnage:	6,074	8,689	15,083	9,606	10,882
ICI Recyclables Tonnage:	8,238	13,356	27,860	21,181	22,112
Total Recyclables Tonnage:	14,312	22,044	42,944	30,787	32,994
Plant Capital Costs:	$397,620	$397,620	$397,620	$397,620	$397,620
Plant Operations Costs:	$567,550	$680,374	$1,055,030	$899,276	$921,241
Total Plant Costs:	$965,170	$1,077,994	$1,452,650	$1,296,896	$1,318,861
Residential Collection Costs:	$1,585,690	$1,321,590	$2,334,880	$2,008,100	$2,689,600
ICI Collection Costs:	$987,910	$1,044,370	$1,953,320	$1,515,640	$2,074,240
Total Collection Costs:	$2,573,600	$2,365,960	$4,288,200	$3,523,740	$4,763,840

Note: All costs and tonnages are annual estimates based on Year 1991.

Table C18 (cont'd)
Recycling System Options - Costs

Option: **SENSITIVITY TEST #13**

Residential System: **Roadside Collection - Blue Box**
Vehicles: **SDRV (PL)**
Diversion: **21% (Additional Group 1 Co-collected Materials)**

ICI System: **Pick-Up Service**
Vehicles: **Roll-off Truck, Cube Van, Packer (FL)**
Diversion: **39.15% (Additional Materials Collected)**

	CPFSA1	*CPFSA2*	*CPFSA3*	*CPFSA4*	*CPFSA5*
Total System Costs:	**$3,538,770**	**$3,443,954**	**$5,740,850**	**$4,820,636**	**$6,082,701**
Total System Costs: (excluding ICI collection)	**$2,550,860**	**$2,399,584**	**$3,787,530**	**$3,304,996**	**$4,008,461**
Total Recyclables Revenue:	$777,020	$1,208,708	$2,387,696	$1,733,316	$1,847,120
Total Net System Costs:	$2,761,750	$2,235,246	$3,353,154	$3,087,320	$4,235,581
Total Net System Costs: (Excluding ICI Collection Costs)	$1,773,840	$1,190,876	$1,399,834	$1,571,680	$2,161,341
Plant Costs per Tonne: (of Total Recyclables)	$67	$49	$34	$42	$40
Net Plant Costs per Tonne: (of Total Recyclables)	$13	($6)	($22)	($14)	($16
Collection Costs per Tonne: (of Total Recyclables)	$180	$107	$100	$114	$144
Residential Collection Costs per Tonne: (of Residential Recyclables)	$261	$152	$155	$209	$247
Total Net System Cost per Tonne: (of Total Recyclables)	$193	$101	$78	$100	$128
Total Net System Cost per Tonne - All Wastes (Excluding ICI Collection Costs)	$36	$16	$10	$16	$20
Total Net System Cost per Household All Wastes (Excluding ICI Collection Costs)	$56	$34	$22	$27	$39

Note: All costs and tonnages are annual estimates based on Year 1991.

Table C19
Recycling System Options - Costs

Option: **SENSITIVITY TEST #14**

Residential System: **Special Biannual Roadside Collection**
Vehicles: **1 and 3 Ton Trucks**
Diversion: **18% (Additional Group 2 Materials Collected)**

ICI System: **Pick-Up Service**
Vehicles: **Roll-off Truck, Cube Van, Packer (FL)**
Diversion: **39.15% (Additional Materials Collected)**

	CPFSA1	*CPFSA2*	*CPFSA3*	*CPFSA4*	*CPFSA5*
Households:	31,462	34,900	62,291	59,205	55,656
Residential Waste Tonnage:	28,925	41,374	71,826	45,743	51,817
ICI Waste Tonnage:	21,042	34,112	71,165	54,101	56,484
Total Waste Tonnage:	49,967	75,486	142,991	99,844	108,301
Residential Recyclables Tonnage:	5,207	7,447	12,929	8,234	9,327
ICI Recyclables Tonnage:	8,239	13,355	27,861	21,182	22,112
Total Recyclables Tonnage:	13,445	20,802	40,790	29,415	31,440
Plant Capital Costs:	$397,620	$397,620	$397,620	$397,620	$397,620
Plant Operations Costs:	$538,000	$695,000	$1,025,000	$890,500	$920,000
Total Plant Costs:	$935,620	$1,092,620	$1,422,620	$1,288,120	$1,317,620
Residential Collection Costs:	$1,864,260	$1,550,630	$2,874,706	$2,365,040	$3,114,230
ICI Collection Costs:	$987,910	$1,044,370	$1,953,320	$1,515,640	$2,074,240
Total Collection Costs:	$2,852,170	$2,595,000	$4,828,026	$3,880,680	$5,188,470

Note: All costs and tonnages are annual estimates based on Year 1991.

Table C19 (cont'd)
Recycling System Options - Costs

Option:	**SENSITIVITY TEST #14**
Residential System:	**Special Biannual Roadside Collection**
Vehicles:	**1 and 3 Ton Trucks**
Diversion:	**18% (Additional Group 2 Materials Collected)**
ICI System:	**Pick-Up Service**
Vehicles:	**Roll-off Truck, Cube Van, Packer (FL)**
Diversion:	**39.15% (Additional Materials Collected)**

	CPFSA1	*CPFSA2*	*CPFSA3*	*CPFSA4*	*CPFSA5*
Total System Costs:	$3,787,790	$3,687,620	$6,250,646	$5,168,800	$6,506,090
Total System Costs: (excluding ICI collection)	$2,799,880	$2,643,250	$4,297,326	$3,653,160	$4,431,850
Total Recyclables Revenue:	$750,136	$1,170,213	$2,320,915	$1,690,777	$1,798,939
Total Net System Costs:	$3,037,654	$2,517,407	$3,929,731	$3,478,023	$4,707,151
Total Net System Costs: (Excluding ICI Collection Costs)	$2,049,744	$1,473,037	$1,976,411	$1,962,383	$2,632,911
Plant Costs per Tonne: (of Total Recyclables)	$70	$53	$35	$44	$42
Net Plant Costs per Tonne: (of Total Recyclables)	$14	($4)	($22)	($14)	($15)
Collection Costs per Tonne: (of Total Recyclables)	$212	$125	$118	$132	$165
Residential Collection Costs per Tonne: (of Residential Recyclables)	$358	$208	$222	$287	$334
Total Net System Cost per Tonne: (of Total Recyclables)	$226	$121	$96	$118	$150
Total Net System Cost per Tonne - All Wastes (Excluding ICI Collection Costs)	$41	$20	$14	$20	$24
Total Net System Cost per Household All Wastes (Excluding ICI Collection Costs)	$65	$42	$32	$33	$47

Note: All costs and tonnages are annual estimates based on Year 1991.

Table C20
Recycling System Options - Costs

Option: **SENSITIVITY TEST #15**

Residential System: **Special Biannual Roadside Collection**
Vehicles: **1 and 3 Ton Trucks**
Diversion: **18% (Additional Group 2 Materials Collected)**

ICI System: **Self-Delivery**
Vehicles: **1/2, 1, and 3 Ton Trucks**
Diversion: **7.83% (Additional Materials Collected)**

	CPFSA1	*CPFSA2*	*CPFSA3*	*CPFSA4*	*CPFSA5*
Households:	31,462	34,900	62,291	59,205	55,656
Residential Waste Tonnage:	28,925	41,374	71,826	45,743	51,817
ICI Waste Tonnage:	21,042	34,112	71,165	54,101	56,484
Total Waste Tonnage:	49,967	75,486	142,991	99,844	108,301
Residential Recyclables Tonnage:	5,207	7,447	12,929	8,234	9,327
ICI Recyclables Tonnage:	1,649	2,671	5,572	4,236	4,423
Total Recyclables Tonnage:	6,855	10,118	18,501	12,470	13,750
Plant Capital Costs:	$397,620	$397,620	$397,620	$397,620	$397,620
Plant Operations Costs:	$375,545	$518,620	$625,000	$558,000	$568,500
Total Plant Costs:	$773,165	$916,240	$1,022,620	$955,620	$966,120
Residential Collection Costs:	$1,864,260	$1,550,630	$2,874,706	$2,365,040	$3,114,230
ICI Collection Costs:	$310,090	$261,400	$443,560	$350,390	$576,720
Total Collection Costs:	$2,174,350	$1,812,030	$3,318,266	$2,715,430	$3,690,950

Note: All costs and tonnages are annual estimates based on Year 1991.

Table C20 (cont'd)
Recycling System Options - Costs

Option: **SENSITIVITY TEST #15**

Residential System: **Special Biannual Roadside Collection**
Vehicles: **1 and 3 Ton Trucks**
Diversion: **18% (Additional Group 2 Materials Collected)**

ICI System: **Self-Delivery**
Vehicles: **1/2, 1, and 3 Ton Trucks**
Diversion: **7.83% (Additional Materials Collected)**

	CPFSA1	*CPFSA2*	*CPFSA3*	*CPFSA4*	*CPFSA5*
Total System Costs:	**$2,947,515**	**$2,728,270**	**$4,340,886**	**$3,671,050**	**$4,657,070**
Total System Costs: (excluding ICI collection)	**$2,637,425**	**$2,466,870**	**$3,897,326**	**$3,320,660**	**$4,080,350**
Total Recyclables Revenue:	$342,352	$509,101	$941,675	$642,237	$704,263
Total Net System Costs:	$2,605,163	$2,219,169	$3,399,211	$3,028,813	$3,952,807
Total Net System Costs: (Excluding ICI Collection Costs)	$2,295,073	$1,957,769	$2,955,651	$2,678,423	$3,376,087
Plant Costs per Tonne: (of Total Recyclables)	$113	$91	$55	$77	$70
Net Plant Costs per Tonne: (of Total Recyclables)	$63	$40	$4	$25	$19
Collection Costs per Tonne: (of Total Recyclables)	$317	$179	$179	$218	$268
Residential Collection Costs per Tonne: (of Residential Recyclables)	$358	$208	$222	$287	$334
Total Net System Cost per Tonne: (of Total Recyclables)	$380	$219	$184	$243	$287
Total Net System Cost per Tonne - All Wastes (Excluding ICI Collection Costs)	$46	$26	$21	$27	$31
Total Net System Cost per Household All Wastes (Excluding ICI Collection Costs)	$73	$56	$47	$45	$61

Note: All costs and tonnages are annual estimates based on Year 1991.

Table C21
Recycling System Options - Costs

Option: **SENSITIVITY TEST #16**

Residential System: **Roadside Collection - Blue Box**
Vehicles: **SDRV (PL)**
Diversion: **13.2% (without Beverage Containers)**

ICI System: **Pick-Up Service**
Vehicles: **Roll-off Truck, Cube Van**
Diversion: **25%**

	CPFSA1	*CPFSA2*	*CPFSA3*	*CPFSA4*	*CPFSA5*
Households:	31,462	34,900	62,291	59,205	55,656
Residential Waste Tonnage:	28,925	41,374	71,826	45,743	51,817
ICI Waste Tonnage:	21,042	34,112	71,165	54,101	56,484
Total Waste Tonnage:	49,967	75,486	142,991	99,844	108,301
Residential Recyclables Tonnage:	3,818	5,461	9,481	6,038	6,840
ICI Recyclables Tonnage:	5,260	8,528	17,791	13,525	14,121
Total Recyclables Tonnage:	9,078	13,989	27,272	19,563	20,961
Plant Capital Costs:	$397,620	$397,620	$397,620	$397,620	$397,620
Plant Operations Costs:	$518,620	$567,550	$855,347	$638,444	$655,409
Total Plant Costs:	$916,240	$965,170	$1,252,967	$1,036,064	$1,053,029
Residential Collection Costs:	$1,506,200	$1,253,610	$2,228,900	$1,932,830	$2,476,270
ICI Collection Costs:	$786,510	$790,870	$1,388,640	$1,093,240	$1,486,980
Total Collection Costs:	$2,292,710	$2,044,480	$3,617,540	$3,026,070	$3,963,250

Note: All costs and tonnages are annual estimates based on Year 1991.

Table C21 (cont'd)
Recycling System Options - Costs

Option: **SENSITIVITY TEST #16**

Residential System: **Roadside Collection - Blue Box**
Vehicles: **SDRV (PL)**
Diversion: **13.2% (without Beverage Containers)**

ICI System: **Pick-Up Service**
Vehicles: **Roll-off Truck, Cube Van**
Diversion: **25%**

	CPFSA1	*CPFSA2*	*CPFSA3*	*CPFSA4*	*CPFSA5*
Total System Costs:	$3,208,950	$3,009,650	$4,870,507	$4,062,134	$5,016,279
Total System Costs: (excluding ICI collection)	$2,422,440	$2,218,780	$3,481,867	$2,968,894	$3,529,299
Total Recyclables Revenue:	$539,076	$843,378	$1,679,154	$1,227,396	$1,303,992
Total Net System Costs:	$2,669,874	$2,166,272	$3,191,353	$2,834,738	$3,712,287
Total Net System Costs: (Excluding ICI Collection Costs)	$1,883,364	$1,375,402	$1,802,713	$1,741,498	$2,225,307
Plant Costs per Tonne: (of Total Recyclables)	$101	$69	$46	$53	$50
Net Plant Costs per Tonne: (of Total Recyclables)	$42	$9	($16)	($10)	($12)
Collection Costs per Tonne: (of Total Recyclables)	$253	$146	$133	$155	$189
Residential Collection Costs per Tonne: (of Residential Recyclables)	$394	$230	$235	$320	$362
Total Net System Cost per Tonne: (of Total Recyclables)	$294	$155	$117	$145	$177
Total Net System Cost per Tonne - All Wastes (Excluding ICI Collection Costs)	$38	$18	$13	$17	$21
Total Net System Cost per Household All Wastes (Excluding ICI Collection Costs)	$60	$39	$29	$29	$40

Note: All costs and tonnages are annual estimates based on Year 1991.

Table C22
Recycling System Options - Costs

Option: **SENSITIVITY TEST #17**

Residential System: **Drop-off Depot**
Vehicles: **Roll-off Container Truck**
Diversion: **5% (High Scenario)**

ICI System: **Self-Delivery**
Vehicles: **1/2, 1 and 3 Ton Trucks**
Diversion: **20% (High Scenario)**

	CPFSA1	*CPFSA2*	*CPFSA3*	*CPFSA4*	*CPFSA5*
Households:	31,462	34,900	62,291	59,205	55,656
Residential Waste Tonnage:	28,925	41,374	71,826	45,743	51,817
ICI Waste Tonnage:	21,042	34,112	71,165	54,101	56,484
Total Waste Tonnage:	49,967	75,486	142,991	99,844	108,301
Residential Recyclables Tonnage:	1,446	2,069	3,591	2,287	2,591
ICI Recyclables Tonnage:	4,207	6,822	14,233	10,820	11,297
Total Recyclables Tonnage:	5,654	8,891	17,824	13,107	13,888
Plant Capital Costs:	$145,058	$145,058	$145,058	$145,058	$145,058
Plant Operations Costs:	$355,000	$370,000	$525,000	$485,000	$485,000
Total Plant Costs:	$500,058	$515,058	$670,058	$630,058	$630,058
Residential Collection Costs:	$2,243,530	$1,542,930	$3,139,380	$2,856,250	$3,194,130
ICI Collection Costs:	$562,910	$462,020	$810,020	$680,970	$1,205,010
Total Collection Costs:	$2,806,440	$2,004,950	$3,949,400	$3,537,220	$4,399,140

Note: All costs and tonnages are annual estimates based on Year 1991.

Table C22 (cont'd)
Recycling System Options - Costs

Option: SENSITIVITY TEST #17

Residential System: Drop-off Depot
Vehicles: Roll-off Container Truck
Diversion: 5% (High Scenario)

ICI System: Self-Delivery
Vehicles: 1/2, 1 and 3 Ton Trucks
Diversion: 20% (High Scenario)

	CPFSA1	*CPFSA2*	*CPFSA3*	*CPFSA4*	*CPFSA5*
Total System Costs:	$3,306,498	$2,520,008	$4,619,458	$4,167,278	$5,029,198
Total System Costs: (excluding ICI collection)	$2,743,588	$2,057,988	$3,809,438	$3,486,308	$3,824,188
Total Recyclables Revenue:	$378,168	$598,772	$1,211,508	$897,964	$948,116
Total Net System Costs:	$2,928,330	$1,921,236	$3,407,950	$3,269,314	$4,081,082
Total Net System Costs: (Excluding ICI Collection Costs)	$2,365,420	$1,459,216	$2,597,930	$2,588,344	$2,876,072
Plant Costs per Tonne: (of Total Recyclables)	$88	$58	$38	$48	$45
Net Plant Costs per Tonne: (of Total Recyclables)	$22	($9)	($30)	($20)	($23)
Collection Costs per Tonne: (of Total Recyclables)	$496	$226	$222	$270	$317
Residential Collection Costs per Tonne: (of Residential Recyclables)	$1,551	$746	$874	$1,249	$1,233
Total Net System Cost per Tonne: (of Total Recyclables)	$518	$216	$191	$249	$294
Total Net System Cost per Tonne - All Wastes (Excluding ICI Collection Costs)	$47	$19	$18	$26	$27
Total Net System Cost per Household All Wastes (Excluding ICI Collection Costs)	$75	$42	$42	$44	$52

Note: All costs and tonnages are annual estimates based on Year 1991.

Table C23
Recycling System Options - Costs

Option:	**SENSITIVITY TEST #18**
Residential System:	**Drop-off Depot**
Vehicles:	**Roll-off Container Truck**
Diversion:	**2% (Low Scenario)**
ICI System:	**Self-Delivery**
Vehicles:	**n. a.**
Diversion:	**0% (Low Scenario)**

	CPFSA1	*CPFSA2*	*CPFSA3*	*CPFSA4*	*CPFSA5*
Households:	31,462	34,900	62,291	59,205	55,656
Residential Waste Tonnage:	28,925	41,374	71,826	45,743	51,817
ICI Waste Tonnage:	21,042	34,112	71,165	54,101	56,484
Total Waste Tonnage:	49,967	75,486	142,991	99,844	108,301
Residential Recyclables Tonnage:	579	827	1,437	915	1,036
ICI Recyclables Tonnage:	0	0	0	0	0
Total Recyclables Tonnage:	579	827	1,437	915	1,036
Plant Capital Costs:	$145,058	$145,058	$145,058	$145,058	$145,058
Plant Operations Costs:	$185,000	$185,000	$200,000	$200,000	$200,000
Total Plant Costs:	$330,058	$330,058	$345,058	$345,058	$345,058
Residential Collection Costs:	$2,110,930	$1,514,720	$3,086,010	$2,828,440	$3,061,800
ICI Collection Costs:	$0	$0	$0	$0	$0
Total Collection Costs:	$2,110,930	$1,514,720	$3,086,010	$2,828,440	$3,061,800

Note: All costs and tonnages are annual estimates based on Year 1991.

Table C23 (cont'd)
Recycling System Options - Costs

Option: **SENSITIVITY TEST #18**

Residential System: **Drop-off Depot**
Vehicles: **Roll-off Container Truck**
Diversion: **2% (Low Scenario)**

ICI System: **Self-Delivery**
Vehicles: **n. a.**
Diversion: **0% (Low Scenario)**

	CPFSA1	*CPFSA2*	*CPFSA3*	*CPFSA4*	*CPFSA5*
Total System Costs:	$2,440,988	$1,844,778	$3,431,068	$3,173,498	$3,406,858
Total System Costs: (excluding ICI collection)	$2,440,988	$1,844,778	$3,431,068	$3,173,498	$3,406,858
Total Recyclables Revenue:	$30,108	$43,004	$74,724	$47,580	$53,872
Total Net System Costs:	$2,410,880	$1,801,774	$3,356,344	$3,125,918	$3,352,986
Total Net System Costs: (Excluding ICI Collection Costs)	$2,410,880	$1,801,774	$3,356,344	$3,125,918	$3,352,986
Plant Costs per Tonne: (of Total Recyclables)	$571	$399	$240	$377	$333
Net Plant Costs per Tonne: (of Total Recyclables)	$518	$347	$188	$325	$281
Collection Costs per Tonne: (of Total Recyclables)	$3,649	$1,831	$2,148	$3,092	$2,954
Residential Collection Costs per Tonne: (of Residential Recyclables)	$3,649	$1,831	$2,148	$3,092	$2,954
Total Net System Cost per Tonne: (of Total Recyclables)	$4,167	$2,177	$2,336	$3,417	$3,235
Total Net System Cost per Tonne - All Wastes (Excluding ICI Collection Costs)	$48	$24	$23	$31	$31
Total Net System Cost per Household All Wastes (Excluding ICI Collection Costs)	$77	$52	$54	$53	$60

Note: All costs and tonnages are annual estimates based on Year 1991.

Table C24
Recycling System Options - Costs

Option: **SENSITIVITY TEST #19**

Residential System: **Drop-off Depot**
Vehicles: **Roll-off Container Truck**
Diversion: **4.2% (Additional Group 1 Materials Collected)**

ICI System: **Self-Delivery**
Vehicles: **1/2, 1, and 3 Ton Trucks**
Diversion: **7.83% (Additional Materials Collected)**

	CPFSA1	*CPFSA2*	*CPFSA3*	*CPFSA4*	*CPFSA5*
Households:	31,462	34,900	62,291	59,205	55,656
Residential Waste Tonnage:	28,925	41,374	71,826	45,743	51,817
ICI Waste Tonnage:	21,042	34,112	71,165	54,101	56,484
Total Waste Tonnage:	49,967	75,486	142,991	99,844	108,301
Residential Recyclables Tonnage:	1,215	1,738	3,017	1,921	2,176
ICI Recyclables Tonnage:	1,649	2,671	5,572	4,236	4,423
Total Recyclables Tonnage:	2,863	4,409	8,589	6,157	6,599
Plant Capital Costs:	$145,058	$145,058	$145,058	$145,058	$145,058
Plant Operations Costs:	$280,000	$350,000	$375,000	$355,000	$355,000
Total Plant Costs:	$425,058	$495,058	$520,058	$500,058	$500,058
Residential Collection Costs:	$2,231,410	$1,534,620	$3,126,130	$2,844,210	$3,109,954
ICI Collection Costs:	$310,090	$261,400	$443,560	$350,390	$576,720
Total Collection Costs:	$2,541,500	$1,796,020	$3,569,690	$3,194,600	$3,686,674

Note: All costs and tonnages are annual estimates based on Year 1991.

Table C24 (cont'd)
Recycling System Options - Costs

Option: **SENSITIVITY TEST #19**

Residential System: **Drop-off Depot**
Vehicles: **Roll-off Container Truck**
Diversion: **4.2% (Additional Group 1 Materials Collected)**

ICI System: **Self-Delivery**
Vehicles: **1/2, 1, and 3 Ton Trucks**
Diversion: **7.83% (Additional Materials Collected)**

	CPFSA1	*CPFSA2*	*CPFSA3*	*CPFSA4*	*CPFSA5*
Total System Costs:	**$2,966,558**	**$2,291,078**	**$4,089,748**	**$3,694,658**	**$4,186,732**
Total System Costs: (excluding ICI collection)	**$2,656,468**	**$2,029,678**	**$3,646,188**	**$3,344,268**	**$3,610,012**
Total Recyclables Revenue:	$155,432	$241,752	$477,540	$346,644	$369,420
Total Net System Costs:	$2,811,126	$2,049,326	$3,612,208	$3,348,014	$3,817,312
Total Net System Costs: (Excluding ICI Collection Costs)	$2,501,036	$1,787,926	$3,168,648	$2,997,624	$3,240,592
Plant Costs per Tonne: (of Total Recyclables)	$148	$112	$61	$81	$76
Net Plant Costs per Tonne: (of Total Recyclables)	$94	$57	$5	$25	$20
Collection Costs per Tonne: (of Total Recyclables)	$888	$407	$416	$519	$559
Residential Collection Costs per Tonne: (of Residential Recyclables)	$1,837	$883	$1,036	$1,480	$1,429
Total Net System Cost per Tonne: (of Total Recyclables)	$982	$465	$421	$544	$578
Total Net System Cost per Tonne - All Wastes (Excluding ICI Collection Costs)	$50	$24	$22	$30	$30
Total Net System Cost per Household All Wastes (Excluding ICI Collection Costs)	$79	$51	$51	$51	$58

Note: All costs and tonnages are annual estimates based on Year 1991.

Table C25
Recycling System Options - Costs

Option: SENSITIVITY TEST #20

Residential System: Drop-off Depot
Vehicles: 1 and 3 Ton Trucks
Diversion: 3.6% (with Group 2 Bulk Materials)

ICI System: Self-Delivery
Vehicles: 1/2, 1, and 3 Ton Trucks
Diversion: 5%

	CPFSA1	*CPFSA2*	*CPFSA3*	*CPFSA4*	*CPFSA5*
Households:	31,462	34,900	62,291	59,205	55,656
Residential Waste Tonnage:	28,925	41,374	71,826	45,743	51,817
ICI Waste Tonnage:	21,042	34,112	71,165	54,101	56,484
Total Waste Tonnage:	49,967	75,486	142,991	99,844	108,301
Residential Recyclables Tonnage:	1,041	1,489	2,586	1,647	1,865
ICI Recyclables Tonnage:	1,052	1,706	3,558	2,705	2,823
Total Recyclables Tonnage:	2,093	3,195	6,144	4,352	4,689
Plant Capital Costs:	$145,058	$145,058	$145,058	$145,058	$145,058
Plant Operations Costs:	$265,000	$341,405	$358,475	$341,405	$341,405
Total Plant Costs:	$410,058	$486,463	$503,533	$486,463	$486,463
Residential Collection Costs:	$2,305,350	$1,643,810	$3,371,090	$3,091,050	$3,345,880
ICI Collection Costs:	$255,750	$204,910	$359,250	$278,530	$490,460
Total Collection Costs:	$2,561,100	$1,848,720	$3,730,340	$3,369,580	$3,836,340

Note: All costs and tonnages are annual estimates based on Year 1991.

Table C25 (cont'd)
Recycling System Options - Costs

Option: **SENSITIVITY TEST #20**

Residential System: **Drop-off Depot**
Vehicles: **1 and 3 Ton Trucks**
Diversion: **3.6% (with Group 2 Bulk Materials)**

ICI System: **Self-Delivery**
Vehicles: **1/2, 1, and 3 Ton Trucks**
Diversion: **5%**

	CPFSA1	*CPFSA2*	*CPFSA3*	*CPFSA4*	*CPFSA5*
Total System Costs:	**$2,971,158**	**$2,335,183**	**$4,233,873**	**$3,856,043**	**$4,322,803**
Total System Costs: (excluding ICI collection)	**$2,715,408**	**$2,130,273**	**$3,874,623**	**$3,577,513**	**$3,832,343**
Total Recyclables Revenue:	$123,821	$191,580	$375,563	$270,779	$289,423
Total Net System Costs:	$2,847,337	$2,143,603	$3,858,310	$3,585,264	$4,033,380
Total Net System Costs: (Excluding ICI Collection Costs)	$2,591,587	$1,938,693	$3,499,060	$3,306,734	$3,542,920
Plant Costs per Tonne: (of Total Recyclables)	$196	$152	$82	$112	$104
Net Plant Costs per Tonne: (of Total Recyclables)	$137	$92	$21	$50	$42
Collection Costs per Tonne: (of Total Recyclables)	$1,223	$579	$607	$774	$818
Residential Collection Costs per Tonne: (of Residential Recyclables)	$2,214	$1,104	$1,304	$1,877	$1,794
Total Net System Cost per Tonne: (of Total Recyclables)	$1,360	$671	$628	$824	$860
Total Net System Cost per Tonne - All Wastes (Excluding ICI Collection Costs)	$52	$26	$24	$33	$33
Total Net System Cost per Household All Wastes (Excluding ICI Collection Costs)	$82	$56	$56	$56	$64

Note: All costs and tonnages are annual estimates based on Year 1991.

Table C26
Recycling System Options - Costs

Option: **SENSITIVITY TEST #21**

Residential System: **Drop-off Depot**
Vehicles: **Roll-off Container Truck**
Diversion: **2.64% (without Beverage Containers)**

ICI System: **Self-Delivery**
Vehicles: **1/2, 1, and 3 Ton Trucks**
Diversion: **5%**

	CPFSA1	*CPFSA2*	*CPFSA3*	*CPFSA4*	*CPFSA5*
Households:	31,462	34,900	62,291	59,205	55,656
Residential Waste Tonnage:	28,925	41,374	71,826	45,743	51,817
ICI Waste Tonnage:	21,042	34,112	71,165	54,101	56,484
Total Waste Tonnage:	49,967	75,486	142,991	99,844	108,301
Residential Recyclables Tonnage:	764	1,092	1,896	1,208	1,368
ICI Recyclables Tonnage:	1,052	1,706	3,558	2,705	2,824
Total Recyclables Tonnage:	1,816	2,798	5,454	3,913	4,192
Plant Capital Costs:	$145,058	$145,058	$145,058	$145,058	$145,058
Plant Operations Costs:	$265,000	$341,405	$358,475	$341,405	$341,405
Total Plant Costs:	$410,058	$486,463	$503,533	$486,463	$486,463
Residential Collection Costs:	$2,130,650	$1,520,170	$3,102,460	$2,831,230	$3,072,470
ICI Collection Costs:	$255,750	$204,910	$359,250	$278,530	$490,460
Total Collection Costs:	$2,386,400	$1,725,080	$3,461,710	$3,109,760	$3,562,930

Note: All costs and tonnages are annual estimates based on Year 1991.

Table C26 (cont'd)
Recycling System Options - Costs

Option: **SENSITIVITY TEST #21**

Residential System: **Drop-off Depot**
Vehicles: **Roll-off Container Truck**
Diversion: **2.64% (without Beverage Containers)**

ICI System: **Self-Delivery**
Vehicles: **1/2, 1, and 3 Ton Trucks**
Diversion: **5%**

	CPFSA1	CPFSA2	CPFSA3	CPFSA4	CPFSA5
Total System Costs:	$2,796,458	$2,211,543	$3,965,243	$3,596,223	$4,049,393
Total System Costs: (excluding ICI collection)	$2,540,708	$2,006,633	$3,605,993	$3,317,693	$3,558,933
Total Recyclables Revenue:	$107,832	$168,696	$335,808	$245,496	$260,784
Total Net System Costs:	$2,688,626	$2,042,847	$3,629,435	$3,350,727	$3,788,609
Total Net System Costs: (Excluding ICI Collection Costs)	$2,432,876	$1,837,937	$3,270,185	$3,072,197	$3,298,149
Plant Costs per Tonne: (of Total Recyclables)	$226	$174	$92	$124	$116
Net Plant Costs per Tonne: (of Total Recyclables)	$166	$114	$31	$62	$54
Collection Costs per Tonne: (of Total Recyclables)	$1,314	$617	$635	$795	$850
Residential Collection Costs per Tonne: (of Residential Recyclables)	$2,790	$1,392	$1,636	$2,344	$2,246
Total Net System Cost per Tonne: (of Total Recyclables)	$1,481	$730	$665	$856	$904
Total Net System Cost per Tonne - All Wastes (Excluding ICI Collection Costs)	$49	$24	$23	$31	$30
Total Net System Cost per Household All Wastes (Excluding ICI Collection Costs)	$77	$53	$52	$52	$59

Note: All costs and tonnages are annual estimates based on Year 1991.

Table C27
Recycling System Options - Costs

Option: **SENSITIVITY TEST #22**

Residential System: **Maximized Wet-Dry Recycling - Coloured Bags**
Vehicles: **Low Compression Packer - SL (Co-collected)**
Diversion: **60%**

ICI System: **Pick-Up Service/Self-Delivery**
Vehicles: **Roll-Off Truck, Cube Van, Packer (FL)/½, 1, 3 Ton Trucks**
Diversion: **66%**

	CPFSA1	*CPFSA2*	*CPFSA3*	*CPFSA4*	*CPFSA5*
Households:	31,462	34,900	62,291	59,205	55,656
Residential Waste Tonnage:	28,925	41,374	71,826	45,743	51,817
ICI Waste Tonnage:	21,042	34,112	71,165	54,101	56,484
Total Waste Tonnage:	49,967	75,486	142,991	99,844	108,301
Residential Recyclables Tonnage:	17,355	24,824	43,096	27,446	31,090
ICI Recyclables Tonnage:	13,888	22,514	46,969	35,707	37,279
Total Recyclables Tonnage:	31,243	47,338	90,065	63,152	68,370
Plant Capital Costs:	$1,217,798	$1,217,798	$3,362,473	$1,485,506	$3,362,473
Plant Operations Costs:	$1,793,433	$2,078,975	$3,532,959	$2,892,559	$3,313,311
Total Plant Costs:	$3,011,231	$3,296,773	$6,895,432	$4,378,065	$6,675,784
Residential Collection Costs:	$3,146,110	$2,266,420	$4,318,120	$3,336,650	$5,493,610
ICI Collection Costs:	$1,781,450	$1,788,270	$3,582,160	$3,641,230	$4,740,980
Total Collection Costs:	$4,927,560	$4,054,690	$7,900,280	$6,977,880	$10,234,590

Note: All costs and tonnages are annual estimates based on Year 1991.

Table C27 (cont'd)
Recycling System Options - Costs

Option: **SENSITIVITY TEST #22**

Residential System: **Maximized Wet-Dry Recycling - Coloured Bags**
Vehicles: **Low Compression Packer - SL (Co-collected)**
Diversion: **60%**

ICI System: **Pick-Up Service/Self-Delivery**
Vehicles: **Roll-Off Truck, Cube Van, Packer (FL)/½, 1, 3 Ton Trucks**
Diversion: **66%**

	CPFSA1	*CPFSA2*	*CPFSA3*	*CPFSA4*	*CPFSA5*
Total System Costs:	$7,938,791	$7,351,463	$14,795,712	$11,355,945	$16,910,374
Total System Costs: (excluding ICI collection)	$6,157,341	$5,563,193	$11,213,552	$7,714,715	$12,169,394
Total Recyclables Revenue:	$1,217,424	$1,850,318	$3,536,499	$2,490,611	$2,690,975
Total Net System Costs:	$6,721,367	$5,501,145	$11,259,213	$8,865,334	$14,219,399
Total Net System Costs: (Excluding ICI Collection Costs)	$4,939,917	$3,712,875	$7,677,053	$5,224,104	$9,478,419
Plant Costs per Tonne: (of Total Recyclables)	$96	$70	$77	$69	$98
Net Plant Costs per Tonne: (of Total Recyclables)	$57	$31	$37	$30	$58
Collection Costs per Tonne: (of Total Recyclables)	$158	$86	$88	$110	$150
Residential Collection Costs per Tonne: (of Residential Recyclables)	$181	$91	$100	$122	$177
Total Net System Cost per Tonne: (of Total Recyclables)	$215	$116	$125	$140	$208
Total Net System Cost per Tonne - All Wastes (Excluding ICI Collection Costs)	$99	$49	$54	$52	$88
Total Net System Cost per Household All Wastes (Excluding ICI Collection Costs)	$157	$106	$123	$88	$170

Note: All costs and tonnages are annual estimates based on Year 1991.

Table C28
Recycling System Options - Costs

Option: **SENSITIVITY TEST #23**

Residential System: **Maximized Wet-Dry Recycling - Coloured Bags**
Vehicles: **Low-compression Packer - SL (Separate Wet/Dry Collection)**
Diversion: **60%**

ICI System: **Pick-Up Service/Self-Delivery**
Vehicles: **Roll-Off Truck, Cube Van, Packer (FL)/½, 1, 3 Ton Trucks**
Diversion: **66%**

	CPFSA1	*CPFSA2*	*CPFSA3*	*CPFSA4*	*CPFSA5*
Households:	31,462	34,900	62,291	59,205	55,656
Residential Waste Tonnage:	28,925	41,374	71,826	45,743	51,817
ICI Waste Tonnage:	21,042	34,112	71,165	54,101	56,484
Total Waste Tonnage:	49,967	75,486	142,991	99,844	108,301
Residential Recyclables Tonnage:	17,355	24,824	43,096	27,446	31,090
ICI Recyclables Tonnage:	13,888	22,514	46,969	35,707	37,279
Total Recyclables Tonnage:	31,243	47,338	90,065	63,152	68,370
Plant Capital Costs:	$1,217,748	$1,217,748	$3,362,473	$1,485,506	$3,362,473
Plant Operations Costs:	$1,793,433	$2,078,975	$3,532,959	$2,892,559	$3,313,311
Total Plant Costs:	$3,011,181	$3,296,723	$6,895,432	$4,378,065	$6,675,784
Residential Collection Costs:	$5,332,248	$4,184,450	$7,644,820	$6,327,320	$9,071,380
ICI Collection Costs:	$1,781,450	$1,788,270	$3,582,160	$2,641,230	$4,740,980
Total Collection Costs:	$7,113,698	$5,972,720	$11,226,980	$8,968,550	$13,812,360

Note: All costs and tonnages are annual estimates based on Year 1991.

Table C28 (cont'd)
Recycling System Options - Costs

Option: **SENSITIVITY TEST #23**

Residential System: **Maximized Wet-Dry Recycling - Coloured Bags**
Vehicles: **Low-compression Packer - SL (Separate Wet/Dry Collection)**
Diversion: **60%**

ICI System: **Pick-Up Service/Self-Delivery**
Vehicles: **Roll-Off Truck, Cube Van, Packer (FL)/½, 1, 3 Ton Trucks**
Diversion: **66%**

	CPFSA1	*CPFSA2*	*CPFSA3*	*CPFSA4*	*CPFSA5*
Total System Costs:	**$10,124,879**	**$9,269,443**	**$18,122,412**	**$13,346,615**	**$20,488,144**
Total System Costs: (excluding ICI collection)	**$8,343,429**	**$7,481,173**	**$14,540,252**	**$10,705,385**	**$15,747,164**
Total Recyclables Revenue:	$1,217,424	$1,850,318	$3,536,499	$2,490,611	$2,690,975
Total Net System Costs:	$8,907,455	$7,419,125	$14,585,913	$10,856,004	$17,797,169
Total Net System Costs: (Excluding ICI Collection Costs)	$7,126,005	$5,630,855	$11,003,753	$8,214,774	$13,056,189
Plant Costs per Tonne: (of Total Recyclables)	$96	$70	$77	$69	$98
Net Plant Costs per Tonne: (of Total Recyclables)	$57	$31	$37	$30	$58
Collection Costs per Tonne: (of Total Recyclables)	$228	$126	$125	$142	$202
Residential Collection Costs per Tonne: (of Residential Recyclables)	$307	$169	$177	$231	$292
Total Net System Cost per Tonne: (of Total Recyclables)	$285	$157	$162	$172	$260
Total Net System Cost per Tonne - All Wastes (Excluding ICI Collection Costs)	$143	$75	$77	$82	$121
Total Net System Cost per Household All Wastes (Excluding ICI Collection Costs)	$226	$161	$177	$139	$235

Note: All costs and tonnages are annual estimates based on Year 1991.

Table C29
Recycling System Options - Costs

Option: **SENSITIVITY TEST #24**

Residential System: **Roadside Collection - Blue Box (20% Higher Prices)**
Vehicles: **SDRV (PL)**
Diversion: **15%**

ICI System: **Pick-Up Service (20% Higher Prices)**
Vehicles: **Roll-off Truck, Cube Van**
Diversion: **25%**

	CPFSA1	*CPFSA2*	*CPFSA3*	*CPFSA4*	*CPFSA5*
Households:	31,462	34,900	62,291	59,205	55,656
Residential Waste Tonnage:	28,925	41,374	71,826	45,743	51,817
ICI Waste Tonnage:	21,042	34,112	71,165	54,101	56,484
Total Waste Tonnage:	49,967	75,486	142,991	99,844	108,301
Residential Recyclables Tonnage:	4,339	6,206	10,774	6,861	7,773
ICI Recyclables Tonnage:	5,261	8,528	17,791	13,524	14,120
Total Recyclables Tonnage:	9,599	14,734	28,565	20,386	21,893
Plant Capital Costs:	$397,620	$397,620	$397,620	$397,620	$397,620
Plant Operations Costs:	$518,620	$567,550	$855,347	$638,444	$655,409
Total Plant Costs:	$916,240	$965,170	$1,252,967	$1,036,064	$1,053,029
Residential Collection Costs:	$1,510,590	$1,256,730	$2,231,210	$1,939,630	$2,493,580
ICI Collection Costs:	$786,510	$790,870	$1,388,640	$1,093,240	$1,486,980
Total Collection Costs:	$2,297,100	$2,047,600	$3,619,850	$3,032,870	$3,980,560

Note: All costs and tonnages are annual estimates based on Year 1991.

Table C29 (cont'd)
Recycling System Options - Costs

Option: **SENSITIVITY TEST #24**

Residential System: **Roadside Collection - Blue Box (20% Higher Prices)**
Vehicles: SDRV (PL)
Diversion: **15%**

ICI System: **Pick-Up Service (20% Higher Prices)**
Vehicles: **Roll-off Truck, Cube Van**
Diversion: **25%**

	CPFSA1	*CPFSA2*	*CPFSA3*	*CPFSA4*	*CPFSA5*
Total System Costs:	$3,213,340	$3,012,770	$4,872,817	$4,068,934	$5,033,589
Total System Costs: (excluding ICI collection)	$2,426,830	$2,221,900	$3,484,177	$2,975,694	$3,546,609
Total Recyclables Revenue:	$725,218	$1,124,073	$2,209,440	$1,596,686	$1,705,027
Total Net System Costs:	$2,488,122	$1,888,697	$2,663,377	$2,472,248	$3,328,562
Total Net System Costs: (Excluding ICI Collection Costs)	$1,701,612	$1,097,827	$1,274,737	$1,379,008	$1,841,582
Plant Costs per Tonne: (of Total Recyclables)	$95	$66	$44	$51	$48
Net Plant Costs per Tonne: (of Total Recyclables)	$20	($11)	($33)	($28)	($30)
Collection Costs per Tonne: (of Total Recyclables)	$239	$139	$127	$149	$182
Residential Collection Costs per Tonne: (of Residential Recyclables)	$348	$202	$207	$283	$321
Total Net System Cost per Tonne: (of Total Recyclables)	$259	$128	$93	$121	$152
Total Net System Cost per Tonne - All Wastes (Excluding ICI Collection Costs)	$34	$15	$9	$14	$17
Total Net System Cost per Household All Wastes (Excluding ICI Collection Costs)	$54	$31	$20	$23	$33

Note: All costs and tonnages are annual estimates based on Year 1991.

Table C30
Recycling System Options - Costs

Option: **SENSITIVITY TEST #25**

Residential System: **Drop-off Depot (20% Higher Prices)**
Vehicles: **Roll-off Container Truck**
Diversion: **3%**

ICI System: **Self-Delivery (20% Higher Prices)**
Vehicles: **1/2, 1, and 3 Ton Trucks**
Diversion: **5%**

	CPFSA1	*CPFSA2*	*CPFSA3*	*CPFSA4*	*CPFSA5*
Households:	31,462	34,900	62,291	59,205	55,656
Residential Waste Tonnage:	28,925	41,374	71,826	45,743	51,817
ICI Waste Tonnage:	21,042	34,112	71,165	54,101	56,484
Total Waste Tonnage:	49,967	75,486	142,991	99,844	108,301
Residential Recyclables Tonnage:	868	1,241	2,155	1,372	1,555
ICI Recyclables Tonnage:	1,052	1,706	3,558	2,705	2,823
Total Recyclables Tonnage:	1,920	2,947	5,713	4,077	4,378
Plant Capital Costs:	$145,058	$145,058	$145,058	$145,058	$145,058
Plant Operations Costs:	$265,000	$341,405	$358,475	$341,405	$341,405
Total Plant Costs:	$410,058	$486,463	$503,533	$486,463	$486,463
Residential Collection Costs:	$2,147,510	$1,522,310	$3,105,750	$2,832,630	$3,077,150
ICI Collection Costs:	$255,750	$204,910	$359,250	$278,530	$490,460
Total Collection Costs:	$2,403,260	$1,727,220	$3,465,000	$3,111,160	$3,567,610

Note: All costs and tonnages are annual estimates based on Year 1991.

Table C30 (cont'd)
Recycling System Options - Costs

Option: **SENSITIVITY TEST #25**

Residential System: **Drop-off Depot (20% Higher Prices)**
Vehicles: **Roll-off Container Truck**
Diversion: **3%**

ICI System: **Self-Delivery (20% Higher Prices)**
Vehicles: **1/2, 1, and 3 Ton Trucks**
Diversion: **5%**

	CPFSA1	*CPFSA2*	*CPFSA3*	*CPFSA4*	*CPFSA5*
Total System Costs:	**$2,813,318**	**$2,213,683**	**$3,968,533**	**$3,597,623**	**$4,054,073**
Total System Costs: (excluding ICI collection)	**$2,557,568**	**$2,008,773**	**$3,609,283**	**$3,319,093**	**$3,563,613**
Total Recyclables Revenue:	$145,056	$224,836	$441,883	$319,325	$340,964
Total Net System Costs:	$2,668,262	$1,988,847	$3,526,650	$3,278,298	$3,713,109
Total Net System Costs: (Excluding ICI Collection Costs)	$2,412,512	$1,783,937	$3,167,400	$2,999,768	$3,222,649
Plant Costs per Tonne: (of Total Recyclables)	$214	$165	$88	$119	$111
Net Plant Costs per Tonne: (of Total Recyclables)	$138	$89	$11	$41	$33
Collection Costs per Tonne: (of Total Recyclables)	$1,252	$586	$607	$763	$815
Residential Collection Costs per Tonne: (of Residential Recyclables)	$2,475	$1,226	$1,441	$2,064	$1,979
Total Net System Cost per Tonne: (of Total Recyclables)	$1,390	$675	$617	$804	$848
Total Net System Cost per Tonne - All Wastes (Excluding ICI Collection Costs)	$48	$24	$22	$30	$30
Total Net System Cost per Household All Wastes (Excluding ICI Collection Costs)	$77	$51	$51	$51	$58

Note: All costs and tonnages are annual estimates based on Year 1991.

Table C31
Recycling System Options - Costs

Option: **SENSITIVITY TEST #26**

Residential System: **Roadside Collection - Blue Box (20% Lower Prices)**
Vehicles: **SDRV (PL)**
Diversion: **15%**

ICI System: **Pick-Up Service (20% Lower Prices)**
Vehicles: **Roll-off Truck, Cube Van**
Diversion: **25%**

	CPFSA1	*CPFSA2*	*CPFSA3*	*CPFSA4*	*CPFSA5*
Households:	31,462	34,900	62,291	59,205	55,656
Residential Waste Tonnage:	28,925	41,374	71,826	45,743	51,817
ICI Waste Tonnage:	21,042	34,112	71,165	54,101	56,484
Total Waste Tonnage:	49,967	75,486	142,991	99,844	108,301
Residential Recyclables Tonnage:	4,339	6,206	10,774	6,861	7,773
ICI Recyclables Tonnage:	5,261	8,528	17,791	13,524	14,120
Total Recyclables Tonnage:	9,599	14,734	28,565	20,386	21,893
Plant Capital Costs:	$397,620	$397,620	$397,620	$397,620	$397,620
Plant Operations Costs:	$518,620	$567,550	$855,347	$638,444	$655,409
Total Plant Costs:	$916,240	$965,170	$1,252,967	$1,036,064	$1,053,029
Residential Collection Costs:	$1,510,590	$1,256,730	$2,231,210	$1,939,630	$2,493,580
ICI Collection Costs:	$786,510	$790,870	$1,388,640	$1,093,240	$1,486,980
Total Collection Costs:	$2,297,100	$2,047,600	$3,619,850	$3,032,870	$3,980,560

Note: All costs and tonnages are annual estimates based on Year 1991.

Table C31 (cont'd)
Recycling System Options - Costs

Option: **SENSITIVITY TEST #26**

Residential System: **Roadside Collection - Blue Box (20% Lower Prices)**
Vehicles: **SDRV (PL)**
Diversion: **15%**

ICI System: **Pick-Up Service (20% Lower Prices)**
Vehicles: **Roll-off Truck, Cube Van**
Diversion: **25%**

	CPFSA1	*CPFSA2*	*CPFSA3*	*CPFSA4*	*CPFSA5*
Total System Costs:	$3,213,340	$3,012,770	$4,872,817	$4,068,934	$5,033,589
Total System Costs: (excluding ICI collection)	$2,426,830	$2,221,900	$3,484,177	$2,975,694	$3,546,609
Total Recyclables Revenue:	$483,478	$749,383	$1,472,960	$1,064,458	$1,136,685
Total Net System Costs:	$2,729,862	$2,263,387	$3,399,857	$3,004,476	$3,896,904
Total Net System Costs: (Excluding ICI Collection Costs)	$1,943,352	$1,472,517	$2,011,217	$1,911,236	$2,409,924
Plant Costs per Tonne: (of Total Recyclables)	$95	$66	$44	$51	$48
Net Plant Costs per Tonne: (of Total Recyclables)	$45	$15	($8)	($1)	($4)
Collection Costs per Tonne: (of Total Recyclables)	$239	$139	$127	$149	$182
Residential Collection Costs per Tonne: (of Residential Recyclables)	$348	$202	$207	$283	$321
Total Net System Cost per Tonne: (of Total Recyclables)	$284	$154	$119	$147	$178
Total Net System Cost per Tonne - All Wastes (Excluding ICI Collection Costs)	$39	$20	$14	$19	$22
Total Net System Cost per Household All Wastes (Excluding ICI Collection Costs)	$62	$42	$32	$32	$43

Note: All costs and tonnages are annual estimates based on Year 1991.

Table C32
Recycling System Options - Costs

Option: **SENSITIVITY TEST #27**

Residential System: **Drop-off Depot (20% Lower Prices)**
Vehicles: **Roll-off Container Truck**
Diversion: **3%**

ICI System: **Self-Delivery (20% Lower Prices)**
Vehicles: **1/2, 1, and 3 Ton Trucks**
Diversion: **5%**

	CPFSA1	*CPFSA2*	*CPFSA3*	*CPFSA4*	*CPFSA5*
Households:	31,462	34,900	62,291	59,205	55,656
Residential Waste Tonnage:	28,925	41,374	71,826	45,743	51,817
ICI Waste Tonnage:	21,042	34,112	71,165	54,101	56,484
Total Waste Tonnage:	49,967	75,486	142,991	99,844	108,301
Residential Recyclables Tonnage:	868	1,241	2,155	1,372	1,555
ICI Recyclables Tonnage:	1,052	1,706	3,558	2,705	2,823
Total Recyclables Tonnage:	1,920	2,947	5,713	4,077	4,378
Plant Capital Costs:	$145,058	$145,058	$145,058	$145,058	$145,058
Plant Operations Costs:	$265,000	$341,405	$358,475	$341,405	$341,405
Total Plant Costs:	$410,058	$486,463	$503,533	$486,463	$486,463
Residential Collection Costs:	$2,147,510	$1,522,310	$3,105,750	$2,832,630	$3,077,150
ICI Collection Costs:	$255,750	$204,910	$359,250	$278,530	$490,460
Total Collection Costs:	$2,403,260	$1,727,220	$3,465,000	$3,111,160	$3,567,610

Note: All costs and tonnages are annual estimates based on Year 1991.

Table C32 (cont'd)
Recycling System Options - Costs

Option: **SENSITIVITY TEST #27**

Residential System: **Drop-off Depot (20% Lower Prices)**
Vehicles: **Roll-off Container Truck**
Diversion: **3%**

ICI System: **Self-Delivery (20% Lower Prices)**
Vehicles: **1/2, 1, and 3 Ton Trucks**
Diversion: **5%**

	CPFSA1	*CPFSA2*	*CPFSA3*	*CPFSA4*	*CPFSA5*
Total System Costs:	**$2,813,318**	**$2,213,683**	**$3,968,533**	**$3,597,623**	**$4,054,073**
Total System Costs: (excluding ICI collection)	**$2,557,568**	**$2,008,773**	**$3,609,283**	**$3,319,093**	**$3,563,613**
Total Recyclables Revenue:	$96,704	$149,892	$294,589	$212,883	$227,308
Total Net System Costs:	$2,716,614	$2,063,791	$3,673,944	$3,384,740	$3,826,765
Total Net System Costs: (Excluding ICI Collection Costs)	$2,460,864	$1,858,881	$3,314,694	$3,106,210	$3,336,305
Plant Costs per Tonne: (of Total Recyclables)	$214	$165	$88	$119	$111
Net Plant Costs per Tonne: (of Total Recyclables)	$163	$114	$37	$67	$59
Collection Costs per Tonne: (of Total Recyclables)	$1,252	$586	$607	$763	$815
Residential Collection Costs per Tonne: (of Residential Recyclables)	$2,475	$1,226	$1,441	$2,064	$1,979
Total Net System Cost per Tonne: (of Total Recyclables)	$1,415	$700	$643	$830	$874
Total Net System Cost per Tonne - All Wastes (Excluding ICI Collection Costs)	$49	$25	$23	$31	$31
Total Net System Cost per Household All Wastes (Excluding ICI Collection Costs)	$78	$53	$53	$52	$60

Note: All costs and tonnages are annual estimates based on Year 1991.

Table C33
Recycling System Options - Costs

Option: **SENSITIVITY TEST #28**

Residential System: **Maximized Wet-Dry Recycling - Wheeled Containers**
Vehicles: **SDRV (2 Compartments)**
Diversion: **60% (Higher Price Scenario)**

ICI System: **Pick-Up Service/Self-Delivery**
Vehicles: **Roll-Off Truck, Cube Van, Packer (FL)/½, 1, 3 Ton Trucks**
Diversion: **66% (Higher Price Scenario)**

	CPFSA1	*CPFSA2*	*CPFSA3*	*CPFSA4*	*CPFSA5*
Households:	31,462	34,900	62,291	59,205	55,656
Residential Waste Tonnage:	28,925	41,374	71,826	45,743	51,817
ICI Waste Tonnage:	21,042	34,112	71,165	54,101	56,484
Total Waste Tonnage:	49,967	75,486	142,991	99,844	108,301
Residential Recyclables Tonnage:	17,355	24,824	43,096	27,446	31,090
ICI Recyclables Tonnage:	13,888	22,514	46,969	35,707	37,278
Total Recyclables Tonnage:	31,243	47,338	90,065	63,152	68,369
Plant Capital Costs:	$1,217,748	$1,217,748	$3,362,473	$1,485,506	$3,362,473
Plant Operations Costs:	$1,793,433	$2,078,975	$3,532,959	$2,892,559	$3,313,311
Total Plant Costs:	$3,011,181	$3,296,723	$6,895,432	$4,378,065	$6,675,784
Residential Collection Costs:	$3,437,650	$2,568,630	$4,817,440	$3,754,090	$6,038,810
ICI Collection Costs:	$1,781,450	$1,788,270	$3,582,160	$2,641,230	$4,740,980
Total Collection Costs:	$5,219,100	$4,356,900	$8,399,600	$6,395,320	$10,779,790

Note: All costs and tonnages are annual estimates based on Year 1991.

Table C33 (cont'd)
Recycling System Options - Costs

Option:	**SENSITIVITY TEST #28**
Residential System:	**Maximized Wet-Dry Recycling - Wheeled Containers**
Vehicles:	**SDRV (2 Compartments)**
Diversion:	**60% (Higher Price Scenario)**
ICI System:	**Pick-Up Service/Self-Delivery**
Vehicles:	**Roll-Off Truck, Cube Van, Packer (FL)/½, 1, 3 Ton Trucks**
Diversion:	**66% (Higher Price Scenario)**

	CPFSA1	*CPFSA2*	*CPFSA3*	*CPFSA4*	*CPFSA5*
Total System Costs:	$8,230,281	$7,653,623	$15,295,032	$10,773,385	$17,455,574
Total System Costs: (excluding ICI collection)	$6,448,831	$5,865,353	$11,712,872	$8,132,155	$12,714,594
Total Recyclables Revenue:	$4,021,070	$6,068,546	$11,478,517	$8,003,564	$8,687,149
Total Net System Costs:	$4,209,211	$1,585,077	$3,816,515	$2,769,821	$8,768,425
Total Net System Costs: (Excluding ICI Collection Costs)	$2,427,761	($203,193)	$234,355	$128,591	$4,027,445
Plant Costs per Tonne: (of Total Recyclables)	$96	$70	$77	$69	$98
Net Plant Costs per Tonne: (of Total Recyclables)	($32)	($59)	($51)	($57)	($29
Collection Costs per Tonne: (of Total Recyclables)	$167	$92	$93	$101	$158
Residential Collection Costs per Tonne: (of Residential Recyclables)	$198	$103	$112	$137	$194
Total Net System Cost per Tonne: (of Total Recyclables)	$135	$33	$42	$44	$128
Total Net System Cost per Tonne - All Wastes (Excluding ICI Collection Costs)	$49	($3)	$2	$1	$37
Total Net System Cost per Household All Wastes (Excluding ICI Collection Costs)	$77	($6)	$4	$2	$72

Note: All costs and tonnages are annual estimates based on Year 1991.

Table C34
Recycling System Options - Costs

Option: **SENSITIVITY TEST #29**

Residential System: **Maximized Wet-Dry Recycling - Wheeled Containers**
Vehicles: **SDRV (2 Compartments)**
Diversion: **60% (Lower Price Scenario)**

ICI System: **Pick-Up Service/Self-Delivery**
Vehicles: **Roll-Off Truck, Cube Van, Packer (FL)/½, 1, 3 Ton Trucks**
Diversion: **66% (Lower Price Scenario)**

	CPFSA1	*CPFSA2*	*CPFSA3*	*CPFSA4*	*CPFSA5*
Households:	31,462	34,900	62,291	59,205	55,656
Residential Waste Tonnage:	28,925	41,374	71,826	45,743	51,817
ICI Waste Tonnage:	21,042	34,112	71,165	54,101	56,484
Total Waste Tonnage:	49,967	75,486	142,991	99,844	108,301
Residential Recyclables Tonnage:	17,355	24,824	43,096	27,446	31,090
ICI Recyclables Tonnage:	13,888	22,514	46,969	35,707	37,278
Total Recyclables Tonnage:	31,243	47,338	90,065	63,152	68,369
Plant Capital Costs:	$1,217,748	$1,217,748	$3,362,473	$1,485,506	$3,362,473
Plant Operations Costs:	$1,793,433	$2,078,975	$3,532,959	$2,892,559	$3,313,311
Total Plant Costs:	$3,011,181	$3,296,723	$6,895,432	$4,378,065	$6,675,784
Residential Collection Costs:	$3,437,650	$2,568,630	$4,817,440	$3,754,090	$6,038,810
ICI Collection Costs:	$1,781,450	$1,788,270	$3,582,160	$2,641,230	$4,740,980
Total Collection Costs:	$5,219,100	$4,356,900	$8,399,600	$6,395,320	$10,779,790

Note: All costs and tonnages are annual estimates based on Year 1991.

Table C34 (cont'd)
Recycling System Options - Costs

Option: **SENSITIVITY TEST #29**

Residential System: **Maximized Wet-Dry Recycling - Wheeled Containers**
Vehicles: **SDRV (2 Compartments)**
Diversion: **60% (Lower Price Scenario)**

ICI System: **Pick-Up Service/Self-Delivery**
Vehicles: **Roll-Off Truck, Cube Van, Packer (FL)/½, 1, 3 Ton Trucks**
Diversion: **66% (Lower Price Scenario)**

	CPFSA1	*CPFSA2*	*CPFSA3*	*CPFSA4*	*CPFSA5*
Total System Costs:	**$8,230,281**	**$7,653,623**	**$15,295,032**	**$10,773,385**	**$17,455,574**
Total System Costs: (excluding ICI collection)	**$6,448,831**	**$5,865,353**	**$11,712,872**	**$8,132,155**	**$12,714,594**
Total Recyclables Revenue:	$876,528	$1,333,826	$2,562,877	$1,801,626	$1,945,062
Total Net System Costs:	$7,353,753	$6,319,797	$12,732,155	$8,971,759	$15,510,512
Total Net System Costs: (Excluding ICI Collection Costs)	$5,572,303	$4,531,527	$9,149,995	$6,330,529	$10,769,532
Plant Costs per Tonne: (of Total Recyclables)	$96	$70	$77	$69	$98
Net Plant Costs per Tonne: (of Total Recyclables)	$68	$41	$48	$41	$69
Collection Costs per Tonne: (of Total Recyclables)	$167	$92	$93	$101	$158
Residential Collection Costs per Tonne: (of Residential Recyclables)	$198	$103	$112	$137	$194
Total Net System Cost per Tonne: (of Total Recyclables)	$235	$134	$141	$142	$227
Total Net System Cost per Tonne - All Wastes (Excluding ICI Collection Costs)	$112	$60	$64	$63	$99
Total Net System Cost per Household All Wastes (Excluding ICI Collection Costs)	$177	$130	$147	$107	$194

Note: All costs and tonnages are annual estimates based on Year 1991.

APPENDIX D

COMMERCIAL AND LARGE NON-PROFIT RECYCLERS LISTINGS

APPENDIX D

NAMES, ADDRESSES AND PHONE NUMBERS FOR THE COMMERCIAL AND LARGE NON-PROFIT RECYCLERS IDENTIFIED IN JANUARY, 1991 SURVEY

1. Carleton County Recycling
P.O. Box 69
Woodstock, NB
E0J 2B0

Phone: 325-9067
Contact: George Peabody

2. SWC Recycling
P.O. Box 21, Station 'A'
Fredericton, NB
E3B 4Y2

Phone: 453-9883
Contact: Pierre Theriault

3. Saint John Recycling
390 Rothesay Avenue
Saint John, NB
E2J 2C4

Phone: 633-1770
Contact: John Whipple

4. Sussex Recycling
P.O. Box 194
Sussex, NB
E0E 1P0

Phone: 432-6980
Contact: Norma Harris

5. Gallants Recycling
Galloway, Kent County

(No longer in business)

6. Miramichi Recycling
32 Queen Street
Chatham, NB
E1N 2M6

Phone: 773-7937
Contact: Clarence Morris

7. Donald Brun Recycling
(Shediac Pallet)
Scoudouc, NB
E0A 1N0

Phone: 532-8255
Contact: Donald Brun

8. Juniper Recycling
88 Toombs St.
Moncton, NB
E1A 3A5

Phone: 858-8110
Contact: Pat Steeves